INSPECTION REPORT

Draft Report

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STORAGE TANK TRAILER INSPECTION

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Environmental Quality Management

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Notice

EXECUTIVE SUMMARY

In the middle of August and September 2009, BakerRisk inspected the condition of seven J. B. Kelly storage tanks and two DANA trailers at the defunct Norphlet Chemical Inc. (NCI) facility in Norphlet, Arkansas regarding both staining and a potentially dangerous corrosion problem affecting the inner surfaces of the stainless steel, over-the-road semi-trailer tankers. BakerRisk was requested to perform visual examinations and provide recommendations on cleaning the storage tanks. It was reported to BakerRisk that the storage tanks had transported MMH (hydrazine) or N_2O_4, so there was a desire to have the storage tanks clean enough for that service.

In addition to the BakerRisk inspection, independent studies were performed by E. I. Dupont, AMKO, and USES on the remedial activities and evaluation of using these storage tanks for hydrazine usage.

The staining condition resulted from deinventorying a series of storage tanks at the defunct Norphlet Chemical Inc. (NCI) facility in Norphlet, Arkansas. The storage tanks were part of the MacMillan Ring Free Oil Refinery that was previously located on that site. This site was taken over by NCI for their operations. Various mixtures of anhydrous hydrofluoric acid (AHF), trichloroethylene (TCE), and several other compounds had been transferred to these storage tanks from various stages of the chemical processing as NCI operations were shut down. NCI was attempting to convert TCE and AHF into a modern, environmentally friendly facility for the manufacture of Halocarbon (R-134a), used in cooling and refrigeration systems.

A total of seven J. B. Kelley trailers were involved in the deinventorying and transportation of the corrosive mixture at the NCI site. The inner tanks of these trailers have four baffle plates to reduce liquid sloshing. These baffles are joined to the inner tank surface with a support structure using reinforcing pads welded to the inner tank surface. The Trailer Nos. for the tanks inspected were: Trailer K807 Serial No. C-09790, Trailer K805 Serial No. C-09590, Trailer K810 Serial No. C-10090, Trailer K803 Serial No. C-09390, Trailer K804 Serial No. C-09490, Trailer K809 Serial No. C-09990, and Trailer K808 Serial No. C-09890.

A total of three DANA trailers were involved in the de-inventorying of this highly toxic and corrosive mixture at the NCI site. BakerRisk was only able to visually assess and examine two of the three DANA trailers, since the third trailer remained at the Veolia ES facility throughout the time that our evaluations were being conducted, awaiting incineration and destruction of its load of hazardous liquid. The two DANA trailers that BakerRisk inspected were Trailer 1190 Serial No. STE-6065 and Trailer 1303 Serial No. STE-6645.

BakerRisk's specific findings for each trailer are discussed further in this report. The common findings from the initial inspection before cleaning found that the tanks have light-to-heavy rust-colored stains and rust-colored and green-colored stains emanating from the weep holes on the reinforcement pads.

As a result of BakerRisk's inspection, a metallurgical study was conducted on samples removed from the storage tanks. A baffle plate sample was removed from a Kelley tank and a sample from the dip tube from a DANA trailer.

Numerous, very small and shallow (about 0.003-inch deep) stress corrosion-like cracks (SCC) were found on the inner tank surfaces of the samples from both trailers. These locations could potentially harbor reactive components within the crevices. These components could interact with either the MMH (hydrazine) or the N_2O_4 and produce a rocket fuel reaction within the trailer. Additionally, BakerRisk also was concerned about the potential for contamination of the hypergolic rocket fuels with whatever compounds remained within these crevices.

As a result, three separate laboratory investigations were undertaken. The first involved a sophisticated Auger-electron examination of the inner surfaces of these SCC crevices. The second involved a bench test to see if the cracks would extend under load. Both the first and second separate laboratory investigation were performed under the supervision of BakerRisk. The third investigation was completely separate from BakerRisk and involved the Hydrazine reaction testing and potential contamination of the hypergolic rocket fuel at the E. I. DuPont laboratories. Based on these tests, it was believed the small cracks would not be an immediate concern, but should be monitored throughout the lifetime of these trailer tanks.

Due to the staining and corrosion, BakerRisk recommended the use of a chemical cleaning process to remove the corrosion and staining. The chemical salt remover, Chlor*Rid (Chlor*Rid International, Inc.), was used as the first cleaning step. However, as expected, this step did not remove all of the staining and some rust blooms from the inner tank surfaces. In order to remove the dark staining and some persistent rust areas after the Chlor*Rid cleaning treatment, while at the same time passivating the inner walls of the tanks, a nitric acid compound was selected (AstroGlo-P, supplied by CHEMDET, INC.). In the case of a few stubborn areas, another application of the cleaning and passivation was required until the stain was eliminated or almost completely removed. After this cleaning treatment, the inner surfaces of these trailer tanks were given a water wash rinse and dried. In some trailers, multiple treatments (i.e., more than two) were required on specific areas of the inner tank surfaces.

BakerRisk re-visited the NCI facility on September 1, 2009 to inspect the seven (7) J. B. Kelley trailers and the two (2) DANA trailers after the Chlor*Rid power wash and Nitric Acid passivation treatments were completed and observed that:

- Heavy rust colored stains were no longer present throughout the tank and baffles.
- Small isolated stain areas were noted and recommended for re-cleaning and re-passivation.
- Some trailers required repeated cleaning and passivation.
    - BakerRisk conducted a third and fourth inspection on several trailer tanks during this trip, and confirmed that after additional re-cleaning and re-passivation those areas were adequate.
    - However, after the repeated cleaning and passivation, some of the weep holes continued to have problems with staining and weeping, and appeared even worse. This was considered an unacceptable condition.

Based on the site inspection, laboratory evaluations, and engineering analysis, BakerRisk's summary of findings are as follows:

1. To fully remove the staining, storage tanks had to be both cleaned and passivated; cleaning alone was not adequate. Often, multiple steps were required to achieve adequate removal of the stain. The multiple cleaning (chloride and fluoride compound removal) and passivation treatments were successfully accomplished as determined by later site surface examinations and laboratory analysis.
2. Detailed metallurgical examination of the inner tank surfaces on test samples from both the Kelley and the DANA trailer tanks revealed numerous and very shallow SCC discontinuities, about 0.003-inch deep. After cleaning and passivation, examinations of the samples from the tanks revealed that the fluoride or chloride compounds within those discontinuities were reduced on most of the samples to zero percent, except for one location.
3. A ductility test conducted on a test sample to determine if the SCC discontinuities could grow in size revealed that the discontinuities blunted and did not grow either in depth or length. Additionally, no embrittlement of the stainless steel was observed in any of these examinations.
4. During the inspection, it was found that the Kelley Trailers with the reinforcement pad and weep holes collected storage tank solution and cleaning solution that caused further staining. This indicated that these locations could not be fully cleaned, and this condition was reported as unacceptable.
5. BakerRisk submitted samples to E. I. DuPont laboratories to determine whether or not Hydrazine would react with the cleaned and passivated inner trailer tank surfaces. Based

on test results, E. I. DuPont laboratories concluded that they did not believe that there would be an adverse chemical reaction when this trailer is placed back into Hydrazine service.

6. Some time after the second cleaning and transportation of trailers, BakerRisk was informed that there were some new areas of staining discovered on the J. B. Kelley trailer tanks. These trailers were closed up and transported to the AMKO Service Company (AMKO) facility in Hope, Arkansas for final fabrication remediation. During the transportation of these trailers, corrosion product leaked from areas where different welds met (i.e., laps and insufficient fusion) and from the various pin holes (porosity) in the welds/trailer interior metal. AMKO and US Environmental Services (USES) performed additional work on these trailer tanks, including removal of the one baffle plate with the four mounting pads containing the weep holes. Additional work was also performed to stop solution leaks from various cavities within the stainless steel welds on a number of these trailers.
7. BakerRisk was not asked to perform any additional inspections after completion of the work done by AMKO and USES. BakerRisk did not inspect the trailers after this work was done, but it is our belief that the new staining most likely occurred as a result of moisture that was left after the final cleaning at NCI, acting in consort with the corrosive chemical liquids that were captured by these voids in the welds as they leaked out onto the inner tank surfaces.

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1 INTRODUCTION

In the middle of August, 2009, BakerRisk was contacted regarding a potentially dangerous corrosion problem affecting several stainless steel, over-the-road semi-trailer tankers. This condition resulted from deinventorying a series of storage tanks at the defunct Norphlet Chemical Inc. (NCI) facility in Norphlet, Arkansas. The storage tanks were part of the MacMillan Ring Free Oil Refinery that was previously located on that site. This site was taken over by NCI for their operations. Various mixtures of anhydrous hydrofluoric acid (AHF), trichloroethylene (TCE), and several other compounds had been transferred to these storage tanks from various stages of the chemical processing as NCI operations were shut down. NCI was attempting to convert TCE and AHF into a modern, environmentally friendly facility for manufacture of Halocarbon (R-134a), used in cooling and refrigeration systems. The NCI process proved to be unsuccessful.

A government inspection of the facility in early 2009 located these storage tanks containing highly toxic and corrosive mixtures, and it was further determined after inspection of the storage tanks that they were inadequate to continue to contain these hazardous chemicals. Since the NCI site was adjacent to the Norphlet City School, an emergency was declared, and work was initiated to rapidly deinventory the tanks of their contents. Disposal by incineration was chosen, and a company with the apparent capabilities was selected (Veolia–ES Industrial Services).

2 BACKGROUND

2.1 Overview

Transportation of these particular hazardous mixtures was not an easy task, since trailers commonly used for this purpose are unsuitable due to the high corrosivity of AHF, the incompatibility with many elastomers of TCE, and the high vapor pressure of the Halocarbon in these mixtures. Therefore, specialized stainless steel trailer tanks were chosen that could withstand the high vapor pressures and that were not expected to react with the anhydrous hydrogen fluoride under the conditions of 2 to 3 percent moisture reported by NCI personnel. Former officials with NCI provided an accounting of the presumed composition of these mixtures. The mixtures were then loaded into these specialized trailers, stored on site, and finally transported to the disposal facility for destruction as the incinerator became available.

Upon the return of these empty trailers to the site, corrosion and staining was discovered on the inner surface of the first trailer tank that was returned. The corrosion and staining remained even after the cleaning procedure initially used by U. S. Environmental Services, LLC (USES) personnel. This procedure is described in detail in Appendix A of this report. The USES cleaning procedure was extended by adding a soda ash, mild abrasive blast of the inner tank surfaces. A greenish substance was observed on portions of the stainless steel surfaces, which was believed to be the result of hydrochloric acid (HCl) coming in contact with the inner surface of the trailer tanks.

Since NCI never identified HCl as being present in these mixtures, the former NCI Plant Manager was asked about its possible presence. The Plant Manager stated that a considerable amount of HCl would have been produced in the NCI Halocarbon production process, and further stated that it should have been removed in a distillation step. He stated that the amounts of HCl that were actually captured from the distillation step never came close to agreeing with the amounts that were predicted. Additionally, the two starting materials, AHF and TCE, for the Phase 1 reactions were also in these storage tank mixtures, along with a tantalum catalyst that was used to drive the reaction. As that reaction might continue within the storage tanks, more HCl would have been generated. Based on this information, it was prudent to assume that HCl was present in these liquid mixtures.

Given the immediate need to safely secure these highly toxic and corrosive mixtures found at the vacant NCI facility, only very restricted options existed for disposal and transportation options. Disposal activities were based on information and analytical data provided by the NCI Plant Manager. Veolia, the incineration contractor, determined that they needed to upgrade their facility in order to handle the complex wastes. Their initial estimate was 4 to 6 weeks to complete the upgrades, but for unspecified reasons, the upgrades took 10-12 weeks resulting in longer than anticipated storage time of the wastes in the tanker trailers prior to disposal.

2.2 The NCI Process

The production of the R-134a halocarbon (1,1,1,2-tetrafluoroethane) was planned to be accomplished by the reaction of trichloroethylene (TCE) with concentrated or anhydrous hydrofluoric acid (AHF) in a series of reactors. These reactions produce a hydrochloric acid (HCl) by-product which was to be distilled and collected as 35% aqueous HCl. The very simplified R-134a process chemistry is shown below:

Phase I – Tantalum Fluoride catalyst

$$\begin{array}{ccc} \mathrm{Cl} & & \mathrm{Cl} \\ | & & | \\ \mathrm{C} & = & \mathrm{C} \\ | & & | \\ \mathrm{H} & & \mathrm{Cl} \end{array} \quad + \quad 3\mathrm{AHF} \quad = \quad \begin{array}{ccccccc} & & \mathrm{F} & & \mathrm{H} & & \\ & & | & & | & & \\ \mathrm{F} & - & \mathrm{C} & - & \mathrm{C} & - & \mathrm{Cl} \\ & & | & & | & & \\ & & \mathrm{F} & & \mathrm{H} & & \end{array} \quad + \quad 2\mathrm{HCl}$$

$$(\mathrm{TCE}) \quad + \quad 3\mathrm{AHF} \quad = \quad (\mathrm{R133a}) \quad + \quad 2\mathrm{HCl}$$

Phase II

$$\begin{array}{ccccccc} & & \mathrm{F} & & \mathrm{H} & & \\ & & | & & | & & \\ \mathrm{F} & - & \mathrm{C} & - & \mathrm{C} & - & \mathrm{Cl} \\ & & | & & | & & \\ & & \mathrm{F} & & \mathrm{H} & & \end{array} \quad + \quad \mathrm{AHF} \quad = \quad \begin{array}{ccccccc} & & \mathrm{F} & & \mathrm{H} & & \\ & & | & & | & & \\ \mathrm{F} & - & \mathrm{C} & - & \mathrm{C} & - & \mathrm{F} \\ & & | & & | & & \\ & & \mathrm{F} & & \mathrm{H} & & \end{array} \quad + \quad \mathrm{HCl}$$

$$(\mathrm{R133a}) \quad + \quad \mathrm{AHF} \quad = \quad (\mathrm{R134a}) \quad + \quad \mathrm{HCl}$$

For every 100 pounds of AHF reacted, 137 pounds of HCl would be produced. These reactions require an excess of AHF to be present to drive the reaction in the direction of the desired products. There are various intermediary compounds as well as several other additives also present in the various chemical equipment mixtures. Intermediate chemical compounds, such as R131 and R132a are also present, as are the compounds potassium hydroxide (KOH) and sodium fluoride (NaF). When this facility was finally closed because the process was incapable of separating the pure R134a halocarbon, this left the storage tanks with contents that included all of the various intermediate compounds as well as TCE, AHF, and most likely HCl.

It is BakerRisk's understanding that after this industrial process was shut down, these various mixtures were left sitting in some of the storage tanks used during halocarbon processing. This was the apparent condition discovered during the government inspection earlier in 2009. Based on available information, once the trailer tankers were identified and procured, then the storage tanks were deinventoried of the various highly corrosive and toxic mixtures.

2.3 Description of Trailers

The removal, storage, and over-the-road transportation of the hazardous mixtures associated with the abandoned NCI required specialized equipment since commonly-used trailers were inadequate for this process. Specialized trailer tanks were identified and chosen. A total of ten specialized trailers were contracted from two different sources. These hazardous mixtures were then loaded into these specialized trailers, stored on site, and transported to the disposal facility (Veolia) as incineration time became available.

Both trailer suppliers provided stainless steel tanks capable of handling AHF with gaskets that could withstand attack by TCE, and with inner tanks designed to ASME requirements for Pressure Vessels. Additionally, all of these stainless steel tankers were designed for either toxic and/or lethal materials transportation. J. B. Kelley supplied a total of seven trailers, and DANA supplied the other three trailers. A detailed description of these trailers is given in Sections 2.3.1 and 2.3.2.

2.3.1 J. B. Kelley Trailers

BakerRisk was informed that the J. B. Kelley Trailers are a specially designed and fabricated (i.e., DOT MC 338/E-3121 Rev. 7) bulk highway shipment container for hypergolic rocket fuel transportation. These trailers are equipped with state-of-the-art safety features that far exceed typical industry standards, and are constructed from 304L stainless steel, consisting of an inner pressure vessel tank built to ASME code for Boiler and Pressure Vessels, and surrounded by an outer containment jacket. A fire-rated insulation bonded to the inner tank within the annular space insulates the inner pressure vessel tank from extreme heat or fire. These trailers are also rated for an extremely high crashworthiness for both side impact and head-on collision (about 10 ft length of honeycomb material at the front of the trailer inner tank absorbs large amounts of energy in the event of a head-on collision). Design for a side impact also far exceeds normal industry standards. Additionally, the trailer valves and piping are enclosed in a covered area protected by roll bars, and each trailer has an emergency valve leak kit to seal off any leaking valve until an appropriate repair can be affected.

BakerRisk was also informed that there was no corrosion allowance used for the inner tank design on the J. B. Kelley trailer tanks per ASME Boiler and Pressure Vessel code. Hence, the vessel and head wall thickness are expected to be very close to the design thickness. According to a literature review of these specialized trailers, government inspectors are to perform monthly examination of the trailers at the J. B. Kelley facility. These government inspectors also perform the same type of inspection at the J. B. Kelley facility prior to the trailer's departure to pick up a load of rocket fuel, again at the pick-up point both before and after loading, and once again at the delivery point before and after unloading. Upon return of the trailer to the J. B. Kelley facility, it is our understanding that a government inspector again reinspects the trailer and at that time, repairs or maintenance are completed as identified and required. These trailers are also hydropneumatically tested at five-year intervals to 1.25 times the inner tank's design maximum allowable pressure rating (i.e., 300 psig).

A total of seven J. B. Kelley trailers were involved in the deinventorying and transportation of the corrosive mixture at the NCI site. The inner tanks of these trailers have four baffle plates to reduce liquid sloshing. These baffles are joined to the inner tank surface with a support structure using reinforcing pads welded to the inner tank surface. The transported products are removed from the trailer tanks by means of a sump and a dip leg system. BakerRisk was not able to examine the fabrication drawings for these trailers, but did examine six of the ASME, U-1A, Manufacturer's Data Report Form for Pressure Vessels, provided on these seven J. B. Kelley trailers.

2.3.2 DANA Trailers

BakerRisk was informed that the three DANA trailers had never been used to transport hypergolic rocket fuel. They represented a specialized industrial trailer design [DOT 412SS], constructed from 316L stainless steel, and included an inner pressure vessel tank built to the ASME Pressure Vessel code surrounded by an outer jacket. These DANA trailers were apparently designed for either toxic and/or lethal (i.e., poisonous) material transportation, but they were not designed for extremely high crashworthiness as were the J. B. Kelley trailers. However, the DANA trailers, as was the case with the J. B. Kelley trailers, have valves and piping enclosed in a covered area and each trailer has an emergency valve leak kit to seal off any leaking valve until an appropriate repair can be made. Also, as with the J. B. Kelley trailers, a sump with a dip leg is used to withdraw the transported liquids.

BakerRisk was not informed as to the nature of the contents that had been transported in these DANA trailers prior to their use at the NCI facility. As with the J. B. Kelley trailers, BakerRisk did not have access to the fabrication drawings for the DANA trailers, and it is unknown if the annular space between the inner tank and the outer jacket contains a gaseous nitrogen blanket to maintain an inert corrosion-free environment or a fire rated insulation bonded to the inner tank. Unlike the J. B. Kelley trailers, the DANA trailers had a considerable corrosion allowance, and hence the vessel and head wall thicknesses were larger than the design minimum thickness. The

DANA trailers do not have baffle plates inside the inner tank, and they also have a lower design maximum allowable pressure rating of 100 psig.

A total of three DANA trailers were involved in the de-inventorying of this highly toxic and corrosive mixture at the NCI site. BakerRisk was only able to visually assess and examine two of the three DANA trailers, since the third trailer remained at the Veolia ES facility throughout the time that our evaluations were being conducted, awaiting destruction of its load of hazardous liquid.

3 Initial Visual Assessment And Trailer Tank Internal Inspection

BakerRisk initially visited the NCI facility on August 20, 2009 to inspect the J. B. Kelley and DANA trailers involved in the deinventorying and transportation of the mixtures. The photographs from these assessments and inspections are shown in Appendix B of this report. This section discusses the condition of the trailers as found during the August 2009 visit by BakerRisk.

3.1 Description of Interior Surfaces and Trailers

Various levels of corrosion and staining remained on the inner surfaces of the trailer tanks, even after the cleaning procedures initially employed by the USES personnel at the Norphlet site, upon the trailers' return from the Violia facility.

3.1.1 J.B. Kelley Trailers

The J.B. Kelley trailers inspected by BakerRisk are described below:

Trailer K807 Serial No. C-09790 (Photographs 1-6)
Inspection notes: Heavy rust-colored stains are present throughout entire tank and baffles. Sample for analysis was taken from the second baffle from the entrance of the tank. The specific location of the sample was on the left side portion of the baffle. This trailer was chosen since it represented the worst corroded and stained condition of all of the J. B. Kelley trailers.

Trailer K805 Serial No. C-09590 (Photographs 7-12)
Inspection notes: Heavy rust-colored stains are present throughout entire tank and baffles.

Trailer K810 Serial No. C-10090 (Photographs 13-16)
Inspection notes: Light rust-colored stains are present throughout entire tank and baffles. Light mechanical marks are located on the bottom between the tank entrance and the first baffle.

Trailer K803 Serial No. C-09390 (Photographs 17–21)
Inspection notes: Moderate rust-colored stains are present throughout entire tank and baffles. Light mechanical marks are located on the bottom, between the tank entrance and the first baffle. Last baffle has weep holes in each pad (backing plate) that is welded to the tank at the farthest baffle from the entrance to tank. Rust blooms are emanating from the hole on the bottom left. A green-colored stain (probably nickel oxide, NiO) is emanating from the weep hole on the top right pad.

Trailer K804 Serial No. C-09490 (Photographs 22-25)
Inspection notes: Moderate rust-colored stains are present throughout entire tank and baffles.

Trailer K809 Serial No. C-09990 (Photographs 26-29)
Inspection notes: Moderate rust-colored stains are present throughout entire tank and baffles.

Trailer K808 Serial No. C-09890 (Photographs 30-34)
Inspection notes: Light to moderate rust-colored stains are present throughout entire tank and baffles.

3.1.2 DANA Trailers

The DANA trailers inspected by BakerRisk are described below:

Trailer 1190 Serial No. STE-6065 (Photographs 35-39)
Inspection notes: Moderate to heavy rust-colored stains are present throughout entire tank. Localized rust blooms are scattered throughout the bottom of the tank. A portion of the stainless steel dip leg was cut and removed for further analysis.

Trailer 1303 Serial No. STE-6645 (Photographs 40-44)
Inspection notes: Moderate rust-colored stains are present throughout entire tank. There are many mechanical scratches on the roof of this tank, and small rust blooms are present throughout these scratches.

3.2 Selection and Removal of Samples

BakerRisk was precluded from taking any samples of the ASME pressure vessel membranes in these trailers since such removal would essentially destroy the expensive J. B. Kelley trailer tanks. When BakerRisk was first on site, we were under the impression that this was also the case for the DANA trailer tanks. Since we could not remove samples of the pressure vessel tank shells and heads, we selected two other trailer components for the removal of test samples for laboratory examination. Both of these internal tank components that were sampled were non-ASME code compliant; they were fabricated from the same type of stainless steel as the selected trailer tanks. Furthermore, they were exposed to the same corrosive liquid in those locations with significant corrosion and staining on the tank shell.

The sample selection philosophy was to perform a worst-case analysis of the condition of these trailers. Of the seven J. B. Kelley specialty trailers and the two DANA specialty trailers that were examined, a determination was made as to which one of the trailers from each supplier was in the worst corroded and stained condition. Based on this, J. B. Kelley trailer K 807 and DANA trailer 1190 were selected for sampling.

The tank component selected from J. B. Kelley trailer K 807 was one of the four stainless steel baffle plates inside of the trailer. The tank component selected from DANA trailer 1190 was the stainless steel dip leg inside of the trailer that extended down to the sump. The selection of the laboratory sample location from each component was based on removing a section of the worst apparent corrosive attack and degree of dark staining on the stainless steel surfaces. Based on a visual characterization of the corrosive and staining effects of these selected sample sites, they were fully representative of the same condition found on the worst locations associated with the pressure vessel surfaces of those trailers.

3.3 Cleaning and Passivation Methods for Inner Trailer Tank Surfaces

There are two distinct ways to remove the corrosion and staining caused by the transporting of corrosive mixtures using these trailers from the NCI site. The first way is to mechanically remove the corrosion and staining by grinding or sanding the entire interior of each trailer. This process would be extremely difficult and slow. Re-passivation of the interior would also be required by using a diluted nitric acid solution [< 20%].

The second method is to chemically clean with a proprietary solution and then re-passivate with dilute nitric acid. BakerRisk recommended using the chemical cleaning process described in detail in Section 4.1 of this report. This approach allows for the use of the abrasive methods as an alternative choice should such a need arise.

4 Selection of the Cleaning and Passivation Treatment

Given the nature of the liquid mixtures that the inner surfaces of these stainless steel trailer tanks were exposed to (i.e., AHF, TCE, HCl, halocarbon, plus other unknown compounds), it was acknowledged that a means to remove both chloride and fluoride compounds from the inner tank surfaces would be required. Additionally, the presence of staining on the inner tank surfaces would require a more aggressive procedure, which would need to be followed by re-passivating the stainless steel surfaces.

4.1 Description of the Cleaning and Passivation Procedure Selected

Based on an already proven method, a solution to remove soluble chloride and fluoride salts from the surface of the inner tank wall, was selected as the first cleaning choice. This initial cleaning method would be followed by a water rinse. Using this method would allow for several of the more aggressive, mechanical abrasion methods to be used as a next choice if needed.

The removal of the dark staining combined with the passivation of the stainless steel inner tank wall is accomplished with the use of a dilute nitric acid solution [< 20%]. For stubborn areas, the use of a medium bristle plastic brush can be employed after allowing the passivation solution to sit on the inner wall and other inner surfaces for about 5 to 10 minutes. The removal of the staining after the pre-soak time, either with or without brushing, would be the indicator determining the end of the passivation treatment.

4.1.1 Chlor*Rid Power Wash Treatment

The ease of removal of soluble salts from metal surfaces can vary considerably depending on the actual conditions. When either chloride or fluoride is involved, the ions attach to a metal surface with a strong electrochemical bond. In order to break these chloride or fluoride ion bonds with the metal surface, a high level of energy is required. That energy can be in the form of mechanical energy or chemical energy, or both. This is why chloride cannot simply be washed off with a garden hose once it is bonded to a metal surface. There are several methods that are typically employed to remove such soluble salts.

These methods are wet chemical solutions, mechanical abrasion, or a combination of the two. Of the wet methods, the use of Ultra High Pressure Water Jetting (UHP-WJ) using a minimum of 3,000 psig water pressure is normally employed, with the addition of a salt removing agent to the water. The chemical salt remover, Chlor*Rid (Chlor*Rid International, Inc.), has been used successfully when added to the high pressure water, so that it combines the mechanical energy of the water jetting with the chemical energy of the Chlor*Rid salt remover. According to Chlor*Rid International, Inc., their product does not pose any issue regarding EPA special handling or remediation requirements. It is claimed that these solutions can be ingested without any harm, although that is not recommended. The Chlor*Rid solutions are biodegradable, and the only health hazard noted on the MSDS is that the solutions pose a mild skin irritant.

The UHP-WJ technique with a hot Chlor*Rid solution (1 to 2%) was used to clean the subject trailer tanks, applied with a zero degree rotating nozzle. This nozzle effectively directed the mechanical energy of the water jet, and when used with the Chlor*Rid salt remover, removed both Chlorine and Fluorine ions to extremely low levels. After this cleaning treatment, the inner surfaces of these trailer tanks were given a water wash rinse and then dried.

This procedure was used as the first cleaning step. However, as expected, this step did not remove all of the staining and some rust blooms from the inner tank surfaces.

4.1.2 Nitric Acid Passivation Treatment

Several methods are typically employed to passivate stainless steel surfaces. The chemical method was again determined to be the easiest way to treat the inside of these trailer tanks. The ease of passivation of the stainless steel inner tank surfaces was considerably improved once the chloride and fluoride ions had been removed from these surface. A passivation solution strips the oxidizing ions from the stainless steel surface, and while mainly used to remove oxygen, the solution will also remove Chloride and Fluoride ions as well. Once these surface contaminating elements are removed, the stainless steel will be less prone to the initiation of surface oxidation and/or other chemical reactions.

In order to remove the dark staining and persistent rust areas after the Chlor*Rid cleaning treatment, while at the same time passivating the inner walls of the tanks, a nitric acid compound (AstroGlo-P, supplied by CHEMDET, INC.) was selected for use. This commercial product was identified by USES, which contains less than 15% nitric acid and less than 1% hydrofluoric acid and has been used successfully in the trailer tank cleaning industry. As this product would be essentially identical to that which BakerRisk could make up in the laboratory, it seemed to be a good solution for use inside of these trailers. This solution was also a very close match to the laboratory passivation treatment solution BakerRisk used on the samples removed from the trailers.

The AstroGlo-P passivation solution was applied to the inner trailer tank surfaces using an industrial sprayer, and it was allowed to remain undisturbed for about 5 to 10 minutes. The inner trailer surfaces were then given another spray application of the solution and brushed with a medium bristle plastic brush to remove any residual staining or rusting. In the case of a few stubborn areas, another application of the passivation solution was sprayed on the inner tank surface and once again brushed until the stain was eliminated or almost completely removed.

After this cleaning treatment, the inner surfaces of these trailer tanks were given a water wash rinse and dried.

4.2 Implementation of Cleaning and Passivating Procedure on Inner Surfaces of the Trailer Tanks on Site

After BakerRisk performed the initial visual assessment and internal trailer tank inspections, USES began ordering the Chlor*Rid and the AstroGlo-P to arrange for the expeditious treatment of the inner surfaces of these trailer tanks. Within several days after BakerRisk performed the initial visual assessments and trailer tank internal inspections, USES began cleaning the trailer tanks with the hot Chlor*Rid solution. At that time, a total of only nine trailers were available for cleaning, as one of the DANA trailers was still at the Veolia – ES disposal site awaiting waste incineration. Shortly after USES commenced the cleaning procedure with the hot Chlor*Rid solution, they received a shipment of the passivation solution (AstroGlo-P). The passivation procedure was then also started on the trailer tanks already cleaned with Chlor*Rid.

Once a trailer had undergone both of these procedures, it was made ready for the next BakerRisk visual assessment and trailer tank internal inspection. The last DANA trailer had still not returned to the NCI site at the time of the the second BakerRisk site visit and evaluation on September 2, 2009.

5 Ultrasonic Thickness Testing

The design of the J. B. Kelley pressure vessel tanks for hypergolic rocket fuel service specified a nominal thickness of 0.446 inch for the tank shell and a nominal thickness of 0.442 inch for the two elliptical ratio heads. In both cases, a corrosion allowance of 0.000 inch was specified. In other words, there was no corrosion allowance. As a result, some concern was expressed as to whether the thickness of these pressure vessel shells and heads had been compromised. While the BakerRisk initial visual examination of the trailer tank interior did not reveal any type of significant corrosive effects, either localized or general in nature, we were informed by J. B. Kelley that knowledge of the wall thickness was to be a factor in the disposition of these trailers.

Accordingly, prior to the second BakerRisk trailer tank inspection, an ultrasonic, nondestructive thickness evaluation was scheduled. All Tech Inspection of Memphis, TN was contacted by site personnel and a nondestructive ultrasonic wall thickness examination was arranged for these trailers. Particular attention was to be paid to the J. B. Kelley trailers as the DANA trailer did have a significant corrosion allowance. Personnel from All Tech Inspections are certified to the American Society of Nondestructive Testing's (ASNT) SNT TC-1A requirements. Using a Panametrics 37DL Ultrasonic thickness measuring unit, with a D790-SM transducer (5 MHz) and an ATI Calibration Block, the All Tech Inspections personnel ultrasonically examined all seven of the J. B. Kelley Trailer tanks and two of the DANA trailer tanks (i.e., 1190 and 1303). [One of the DANA trailers was still at the incineration contractor at the time of the inspection.]

Thickness readings were taken on the inner surface of the stainless steel tanks with five (5) readings taken on each end head. One reading was taken at the center of each head, and four (4) readings were taken at 12:00; 3:00; 6:00; and 9:00 o'clock on each head. Then, starting one inch away from the end cap weld, four (4) ultrasonic thickness readings were again taken at 12:00; 3:00; 6:00; and 9:00 o'clock on the tank shell wall, and then four (4) more readings, every two (2) feet further from the front end cap weld, until finally ending one inch away from the back end cap weld. The ultrasonic readings taken by the All Tech Personnel are given in Appendix C.

These ultrasonic measurements are subject to both random and systematic errors, and to comprehensively review these results, a measured 5% reduction below the minimum thickness was taken to be significant for any single given reading. Of the J. B. Kelley trailer tanks, five (5) out of the seven (7) did not have any reading that fell below 95 percent of the minimum thickness as set forth in the U-1A Manufacturer's Data Report Form for those ASME pressure vessels. Of the other two (2) J. B. Kelley trailers, trailer K808, had one reading that was 0.002 below the 95 percent thickness value. This represents only one reading out of a total of sixty taken on each one of these vessel shells. This is not considered significant. The other J. B. Kelley trailer, K803, had three (3) readings that were in the range of 0.001 to 0.002 inch below the 95 percent thickness value. As these readings were widely spaced from each other, this also was not taken to be significant.

As the DANA trailer ASME pressure vessel tanks did indeed have a significant corrosion allowance, it was not surprising that all of the ultrasonic thickness measurements taken on those tanks were found to be well above the minimum thickness as indicated on the trailer nameplate. It is BakerRisk’s opinion, based on the visual appearance of the inner diameter surface, and these ultrasonic thickness readings, that the ASME pressure vessel thickness of the J. B. Kelley trailer tanks is not an issue in the continued use of those trailers. Additionally, the DANA trailer tank wall thickness is also not an issue in the continued use of those trailers.

6 LABORATORY SAMPLE TESTING DISCUSSION AND RESULTS

Two metal samples were removed from the subject stainless steel trailer tanks at the Norphlet Chemical facility for further analysis at a metallurgical laboratory (see Section 3.2). A triangular portion (18" x 18" x 26") of one of four baffle plates inside of the J. B. Kelley trailer K807 was removed, as was about a four-foot length of the lower portion of the dip leg on the DANA 1190 trailer. Since the DANA trailers did not have any baffle plates, the only easily removable stained and corroded section available was the internal dip leg. These two trailers were selected for a worst case analysis. The sample locations selected were badly stained and had heavy corrosive residues in keeping with this worst-case sample selection.

The CD ROM provided as Appendix D of this report contains:

- Photomacrographs of the artifacts and the two as-received samples
- Photomacrographs of the specimens removed from the two samples for further laboratory analysis
- The SEM semi-quantitative EDS results of the as-received condition
- The SEM semi-quantitative EDS results of the Chlor*Rid cleaned condition
- The SEM semi-quantitative EDS results of the cleaned and passivated condition
- Photomicrographs of the removed specimens showing very small stress corrosion cracking (SCC) surface discontinuities, and mounted brown slurry samples for EDS analysis
- Photomacrographs and photomicrographs of the bent baffle plate test specimen
- The SEM semi-quantitative EDS results of the bent specimen surface
- The SEM semi-quantitative EDS results of the brownish slurry

6.1 Surface Treatment, Cleaning and Passivation of Removed Trailer Samples

The initial metallurgical laboratory work was conducted on the as-received specimens removed from the two trailer samples, and involved both scanning electron microscope (SEM) examinations and energy dispersive spectroscopy (EDS), semi-quantitative analyses of the corrosion products, and stain residue on these sample surfaces. After the initial as-received examinations had been completed, these same specimens removed from the baffle plate on the J. B. Kelley trailer No. 807 and the dip leg pipe specimens removed from the DANA trailer 1190 were subjected to the identical cleaning procedure used to clean and passivate the inside of these trailers. A 3,000 psig, high pressure water jet power wash was employed with a hot 1 to 2% Chlor*Rid solution, using a zero degree rotating nozzle. After the Chlor*Rid cleaning treatment, the two removed samples were given a water wash rinse, and then dried. Passivation was accomplished using a laboratory mixed solution of 20% Nitric Acid, and after treatment, the two removed samples were given a water wash rinse, and then dried.

Additionally, two samples were taken of the brownish slurry found within the trailer tanks. One was labeled “Y” (a light brownish tan with green particles) and the other was labeled “Z” (medium brown in color). These deposits were collected during the initial USES cleaning procedures, and once in the laboratory these deposits were also subjected to various EDS semi-quantitative analyses of the base brownish deposits, as well as the bright greenish embedded particles.

6.2 SEM/EDS Surface Analysis

The composition of Fluorine is very difficult to obtain with standard EDS procedures in ferrous alloys. The Fluorine peak is masked by the lower energy iron peak, and a software program can be employed to measure the distortion of the low energy iron peak, and thereby estimate the level of Fluorine present in the specimen. While these results have a low accuracy, they certainly can be used to ascertain the presence or the absence of Fluorinein the analysis.

The results of the EDS analyses are shown in the table below:

Table 1. EDS Semi-Quantitative Analysis Results

As Received Condition – 11 Specimens, 22 Locations		
Baffle Plate examination	Fluoride	5.52% average
(J. B. Kelley K807) 10 areas	Chloride	0.10% average
Dip Leg Pipe examination	Fluoride	6.68% average
(DANA 1190) 12 areas	Chloride	1.03% average
CHLOR*RID Cleaned – 10 Specimens– 23 Locations		
Baffle Plate examination	Fluoride	1.28% average
(J. B. Kelley K807) 12 areas	Chloride	0.22% average
Dip Leg Pipe examination	Fluoride	1.59% average
(DANA 1190) 11 areas	Chloride	0.35% average
Cleaned and Passivated – 6 Specimens – 13 Locations		
Baffle Plate examination	Fluoride	0.00% average
(J. B. Kelley K807) 10 areas	Chloride	0.005% average
Dip Leg Pipe examination	Fluoride	0.00% average
(DANA 1190) 3 areas	Chloride	0.23% average

The Chor*Rid cleaning and passivation treatment had a dramatic effect on both the J. B. Kelley and the DANA Fluorine levels – essentially reducing them to non-detectable levels. Additionally, on the J. B. Kelley trailer tanks, the Chlorine levels were also reduced to essentially a non-detectable level. The relatively higher levels of Chlorine in the DANA trailer tanks could be a reflection of the types of contents that those particular trailers had been loaded with in the past. For our worst-case analysis, the primary concern was the J. B. Kelley trailer tanks, and it has been demonstrated that both Fluorine and Chlorine have been successfully remediated by the proper use of the cleaning and passivation treatment.

6.3 Metallurgical & Metallographic Analysis of Specimen Cross Sections

A total of ten metallographic mounted specimens from both trailer samples were examined with a metallographic microscope. Those examinations revealed typical austenitic microstructures consistent with both a 304L and a 316L stainless steel. Additionally, this laboratory metallographic examination also revealed the presence of numerous and very small areas of SCC on those inner surfaces of the stainless steel exposed to the de-inventoried solution, combined acid solution. These SCC discontinuities are very small, penetrating only about 0.001 to 0.003 inch into the tank shell, but turning and running parallel to the tank ID surface for an average length of about 0.002 to 0.005 inch. They are very tight cracks.

6.4 Ductility and Bend Testing Analysis

To discount the detrimental structural effects of these very small SCC discontinuities, a ductility test was employed, similar to the bend tests used in welding procedures and welder qualification testing. Bending a portion of the J. B. Kelley trailer K807 baffle plate 180 degrees with a bend radius equal to the baffle plate thickness applied an outer fiber tensile elongation of about 33 percent to the specimen. From a visual and binocular microscope examination, none of the SCC discontinuities appeared to grow in size. A metallographic examination of these SCC locations after bending also revealed that the discontinuities blunted and did not grow in size, either in depth or length.

Additionally, no embrittlement of the stainless steel was observed in any of these examinations. Given the large amount of ductility inherent in these stainless steel components, there does not appear to be any structural integrity problem with these tiny discontinuities, provided they are not subjected again to any solutions that will cause these SCC discontinuities to progressively grow and get larger with time. However, more importantly, from the point of view of harboring reactive components within these SCC crevices that could potentially interact with MMH (hydrazine) and produce a rocket fuel reaction within the trailer, this situation was investigated further and results are addressed in Section 8 of this report.

6.5 Collected Deposit Analysis

The SEM semi-quantitative compositional analysis of the slurry deposits and the greenish particles indicated significant amounts of Fluorine (~45 to 54%) and Oxygen (~23 to 54%). There was only a slight amount of Chlorine (~0.08 to 0.10%) present. Whereas the results from the brownish deposits did not reveal any Nickel present, significant amounts of iron, chromium, and nickel with lower oxygen content was found in the greenish particles. Based on previous analysis of stainless steel, this greenish color could be the result of a nickel-fluoride compound or possibly a nickel – iron – chromium – fluoride compound.

7 SECOND VISUAL ASSESSMENT AND TRAILER TANK INTERNAL INSPECTION

BakerRisk re-visited the NCI facility on September 1, 2009 to inspect the seven (7) J. B. Kelley trailers and the two (2) DANA trailers after the Chlor*Rid power wash and Nitric Acid passivation treatments were completed.

7.1 Description of Trailer Surfaces

7.1.1 J.B. Kelley trailers

The J.B. Kelley trailers that Baker Risk re-inspected are described below. The photographs from this inspection are provided in Appendix E.

Trailer K807 Serial No. C-09790 (Photographs 45-48)
Inspection Notes: Heavy rust colored stains were no longer present throughout the tank and baffles but two small areas were noted for re-cleaning and re-passivation. BakerRisk's third inspection confirmed that the re-cleaned and re-passivated areas were adequate. BakerRisk recommends that the trailer be re-inspected, re-cleaned and re-passivated as needed after the vent piping is removed.

Trailer K805 Serial No. C-09590 (Photographs 49-52)
Inspection Notes: Heavy rust colored stains were no longer present throughout entire tank and baffles. A few areas on the baffle were marked for re-cleaning and –re-passivation. BakerRisk's third inspection confirmed that the re-cleaned and re-passivated areas were adequate. BakerRisk recommends that the trailer be re-inspected, re-cleaned and re-passivated as needed after the vent piping is removed.

Trailer K810 Serial No. C-10090 (Photographs 53-56)
Inspection Notes: Light rust colored stains were no longer present throughout entire tank and baffles. At this time no further work was needed. BakerRisk recommends that the trailer be re-inspected, re-cleaned and re-passivated as needed after the vent piping is removed.

Trailer K803 Serial No. C-09390 (Photographs 57-66)

Inspection Notes: Moderate rust colored stains are no longer present throughout entire tank and baffles. The last baffle still has problems with the weep holes. Rust blooms are emanating from the hole on the bottom left. Green colored nickel oxide (NiO) is emanating from the weep hole on the top right pad and appears worse than BakerRisk's first inspection. It was recommended that USES re-clean and re-passivate both areas. BakerRisk's third inspection found that the NiO was still emanating from the weep hole. This area was again re-cleaned and re-passivated. BakerRisk's fourth inspection confirmed that this re-cleaning and re-passivation effort was temporarily successful. However, the weep holes are still present and are likely to cause further problems. BakerRisk recommends that each pad with a weep hole be removed, re-cleaned, and re-passivated prior to reinstalling new pads. BakerRisk is of the opinion that this is the only method available to ensure that these areas would not be a problem in the future. BakerRisk also recommends that the trailer be re-inspected, re-cleaned and re-passivated as needed after the vent piping is removed.

Trailer K804 Serial No. C-09490 (Photographs 67-70)

Inspection Notes: Moderate rust colored stains are no longer present throughout entire tank and baffles. At this time no further work was needed. BakerRisk recommends that the trailer be re-inspected, re-cleaned and re-passivated as needed after the vent piping is removed.

Trailer K809 Serial No. C-09990 (Photographs 71-74)

Inspection Notes: Moderate rust colored stains were no longer present throughout entire tank and baffles. A few areas on the baffle were marked for re-cleaning and re-passivation. BakerRisk's third inspection confirmed that the re-cleaned and re-passivated areas were adequate. BakerRisk recommends that the trailer be re-inspected, re-cleaned and re-passivated as needed after the vent piping is removed.

Trailer K808 Serial No. C-09890 (Photographs 75-78)

Inspection Notes: Light to moderate rust colored stains are no longer present throughout entire tank and baffles. At this time no further work was needed. BakerRisk recommends that the trailer be re-inspected, re-cleaned and re-passivated as needed after the vent piping is removed.

7.1.2 DANA Trailers

The DANA trailers that BakerRisk re-inspected are described below:

Trailer 1190 Serial No. STE-6065 (Photographs 79-82)
Inspection Notes: Moderate to heavy rust colored stains were no longer present throughout the entire tank. There still was localized rust blooms scattered throughout the bottom of the tank. The top portion of the tank was not cleaned and there were still moderate rust stains throughout. BakerRisk recommended that the entire trailer be re-cleaned and re-passivated. BakerRisk's third inspection confirmed that the re-cleaned and re-passivated areas were adequate. BakerRisk also recommends that the trailer be re-inspected prior to re-installing the stainless steel dip leg.

Trailer 1303 Serial No. STE-6645 (Photographs 83-86)
Inspection Notes: Moderate rust colored stains are no longer present throughout the entire tank. As previously stated, there are many mechanical scratches located on the roof of this tank and small rust blooms are still present throughout these areas. It was recommended that USES re-clean and re-passivate these scratch areas, but BakerRisk was unable to perform a third inspection.. This trailer should have been re-inspected after this procedure was completed. BakerRisk also recommends that the trailer be re-inspected prior to re-installing the stainless steel dip leg.

8 ADDITIONAL LABORATORY EXAMINATION AND TESTING

The numerous very small and tight SCC areas found on the inner tank surfaces of the trailers could potentially harbor reactive components within these SCC crevices. These components could interact with either the MMH (hydrazine) or the N_2O_4 and produce a rocket fuel reaction within the trailer. Additionally, BakerRisk was concerned about the potential for contamination of the hypergolic rocket fuels with whatever compounds remained within these crevices. As a result, two separate laboratory investigations were undertaken. The first involved a more sophisticated Auger SEM examination at the Evans Analytical Group of the inner surfaces of these SCC crevices. This analysis was performed in conjunction with BakerRisk. The other completely separate investigation involved the Hydrazine reaction testing and potential contamination of the Hypergolic rocket fuel at the E. I. DuPont laboratories. The reports and the supporting documentation of both investigations are provided in Appendix F.

8.1 Evans Analytical Group – Auger SEM Evaluation

BakerRisk submitted three samples to the Evans Analytical Group for semi-quantitative, Auger Electron Spectroscopy (AES) analysis. The samples were identified as A, B, and C and were taken from the 304L stainless steel baffle plate in the J. B. Kelley K807 trailer tank. The sample indicated as A was just cleaned, B was both cleaned and passivated, and C was cleaned and passivated twice. The three samples had been treated, cross-sectioned, and polished. The goal of this analysis was to look for the presence of chlorine, fluorine, or oxides in the very small SCC discontinuities on each of the three samples. The quantification of the elements was accomplished by using elemental sensitivity factors.

The three samples were mounted on a stainless steel puck and placed in the system load-lock. Clean tweezers and gloves were used for all sample handling. No additional cleaning steps were implemented. After sufficient evacuation, the sample puck was inserted into the analytical chamber and placed in front of the analyzer. Secondary electron imaging was used to locate and record areas of analysis.

Survey spectra were generally obtained from two spots near each SCC area analyzed. One baseline survey was obtained from the polished stainless steel surface and the second from a tiny SCC crevice. No chloride or fluoride was ever detected in any of these SCC discontinuities, with one exception. A suggestion of the presence of chloride was only found on a very tight crack in sample A. So chlorides could be present in isolated locations. Most of the crack crevices did contain carbon and one also contained aluminum and oxygen (possibly Al_2O_3 polishing materials embedded during sample preparation). It is likely that the carbon is a result of the hydrocarbon lubricating oil used in the preparation of these polished samples.

Samples B and C they were also sputter cleaned in an attempt to reduce the presence of carbon in the cracks and look for any evidence of chlorine and fluorine. Neither chlorine nor fluorine was detected in any of these cracks. Many of the corrosion crack areas were also elementally mapped to look for any locations that contained less carbon and possibly areas that contained oxides or chloride. Again, none were found. It would appear that there are non-detectible amounts of chlorine or fluorine present in these SCC crevices; however, the oxygen levels in some of these SCC crevices are quite high. While the oxygen does not appear to be associated with iron, its chemical bonding with either chromium or nickel cannot be ruled out. It is also possible that the oxygen is a result of the hydrocarbon lubricating oil used in the preparation of these polished samples.

BakerRisk strongly suggested that a remediated stainless steel sample be subjected to a direct test with Hydrazine to assess the potential of an adverse chemical reaction or possible contamination of the Hydrazine from components with these SCC crevices. As a result, two samples were sent to the E. I. DuPont Laboratories for such evaluations.

8.2 E. I DuPont Laboratory Testing of Hydrazine Reaction

BakerRisk submitted two samples to the E. I. DuPont Laboratories for direct testing with Hydrazine. The samples were identified as 1 and 2 and they were taken from the 304L stainless steel baffle plate in the J. B. Kelley K807 trailer tank. Sample 1 had been given a single passivation treatment after the Chlor*Rid hot solution cleaning treatment with the 3,000 psi power washer. Sample 2 had been given two passivation treatments after the Chlor*Rid cleaning. This reflected the technique used in two different types of stained areas of these J. B. Kelley trailer tanks.

These two samples were first examined microscopically and with a high-intensity light to determine whether there was any visual staining, corrosion, etc. No evidence of gross staining or corrosion was detected. The samples were then placed in beakers and liquid Hydrazine was placed on one surface of each coupon. A control test was also performed using the same amount of Hydrazine in a glass beaker without a sample present. The samples were observed using high-intensity light for a period of 2 hours. During this time there was no evidence of any chemical reaction. The following observations were made as a result of this testing:

- No discoloration of either the samples or the Hydrazine liquid occurred.
- There was no bubbling or other evidence of a reaction.
- There was no visible indication of any interaction of the Hydrazine with the stainless steel samples other than “wetting” by the Hydrazine.
- No formation of any precipitate was observed.

After two hours, a pipette was used to remove the Hydrazine that had not evaporated. The Hydrazine was examined visually with a high-intensity light and no discoloration or turbidity was observed. The small remaining Hydrazine was allowed to evaporate until it was completely dry. The samples were microscopically examined again with high-intensity light. There was no evidence of any discoloration or any evidence of a chemical reaction. Furthermore, there was no evidence of any changes between the areas of the samples that were exposed to the Hydrazine and those areas that were not exposed.

The samples were then water-washed and again examined closely for any evidence of a chemical reaction. No discoloration, corrosion, or other evidence of a reaction was observed. Therefore, after being exposed to the Hydrazine and water rinse, the surface of the stainless steel has remained unaffected. The E. I. DuPont laboratories concluded that they did not believe that there would be an adverse chemical reaction when this trailer is placed back into Hydrazine service.

9 RECENT SEEPAGE OF CORROSIVE FLUID FROM WELDS AND WEEP HOLES IN THE J. B. KELLEY TRAILERS

Sometime after the second cleaning and second inspection visit, BakerRisk was informed that there were some areas of new corrosion discovered on the J. B. Kelley trailer tanks. These trailers were closed up and transported to the AMKO Service Company (AMKO) facility in Hope, Arkansas for the final fabrication remediation on these Kelley trailers. During the transportation of these trailers, corrosion product leaked from areas where different welds met (i.e., laps and insufficient fusion) and from the various pin holes (porosity) in the welds/trailer interior metal. This new corrosive reaction most likely occurred as a result of moisture that was left after the final cleaning at NCI, acting in consort with the corrosive chemical liquids that were captured by these voids in the welds, as they leaked out onto the inner tank surfaces.

BakerRisk was also informed that additional corrosive liquids leaked out from the weep holes in the reinforcing pads on one of the baffles inside of J. B. Kelley trailer K803. There was some conjecture that this liquid could be Hydrazine or N_2O_4. It is much more likely that this new corrosion is due to the entrapment of the corrosive and toxic acids that were removed from the NCI facility, leaking out from these hidden voids.

BakerRisk was very concerned about the significant corrosive liquid leakage from the weep holes in the reinforcing pads on that single baffle inside of the J. B. Kelley trailer K803. Without the ability to clean and passivate the area between the pad plate and the ASME pressure vessel shell, a risk of reaction between Hydrazine and any trapped solution or corrosion residue is possible. BakerRisk eventually questioned even the appropriateness of attempting to seal-weld those weep holes and these concerns were openly discussed with all appropriate parties.

Based on a conference call with the clients, it was decided to remove that one affected baffle plate with the weep hole pad plates and remediate the affected areas. BakerRisk was informed that USES would be addressing and analyzing the remediation of all of these recent corrosion problems on the J. B. Kelley trailer tanks.

10 SUMMARY OF FINDINGS

BakerRisk's findings are listed below, based on the site inspection, laboratory evaluations, and engineering analysis:

To fully remove the staining, the trailer tanks had to be both cleaned and passivated; cleaning alone was not adequate. Often multiple steps were required to get an adequate removal of the stains. The multiple cleaning (chloride and fluoride compound removal) and passivation treatments were successfully accomplished as determined by later site surface examinations and analysis.

1. Detailed metallurgical examination of the inner tank surfaces on test samples from both the Kelley and the DANA trailer tanks revealed numerous and very shallow SCC discontinuities, to a maximum depth of about 0.003-inch deep. After cleaning and passivation, examinations of the samples from the tanks revealed that the fluoride or chloride compounds within those discontinuities were reduced on most of the samples to zero precent, except for one location.
2. A ductility test that was conducted on a test sample to determine if the SCC discontinuities could grow in size revealed that the discontinuities blunted and did not grow either in depth or length. Additionally, no embrittlement of the stainless steel was observed in any of these examinations.
3. During the inspection, it was found that the Kelley Trailers with the reinforcement pad and weep holes collected the trailer tank hazardous waste solution as well as the cleaning solution, and that caused further staining. This indicated that these locations could not be fully cleaned.
5. BakerRisk submitted samples to E. I. DuPont laboratories for Hydrazine reaction studies on the inner trailer tank surfaces. E. I. DuPont concluded that they did not believe an adverse chemical reaction would occur when this trailer is placed back into Hydrazine service.
6. Some time after the second cleaning and transportation of trailers, BakerRisk was informed that there were some new areas of staining discovered on the J. B. Kelley trailer tanks. These trailers were closed up and transported to the AMKO Service Company (AMKO) facility in Hope, Arkansas for final fabrication remediation. During the transportation of these trailers, corrosion product leaked from areas where different welds met (i.e., laps and insufficient fusion) and from the various pin holes (porosity) in the welds/trailer interior metal. AMKO and US Environmental Services (USES) performed additional work on these trailer tanks, including removal of the one baffle plate with the four mounting pads containing the weep holes. Additional work was also performed to stop solution leaks from various cavities within the stainless steel welds on a number of these trailers.

8. BakerRisk was not asked to perform any additional inspections after completion of the work done by AMKO and USES. BakerRisk did not inspect the trailers after this work was done, but it is our belief that the new staining most likely occurred as a result of moisture that was left after the final cleaning at NCI, acting in consort with the corrosive chemical liquids that were captured by these voids in the welds as they leaked out onto the inner tank surfaces.

APPENDIX A. CLEANING PROCEDURE USED BY U. S. ENVIRONMENTAL SERVICES, LLC (USES)

24 HOUR SERVICE

UNITED STATES ENVIRONMENTAL SERVICES, L.L.C.

CORROSIVE LIQUID CLEANING AND PURGING GUIDELINES

NORPHLET CHEMICAL HF PROJECT
NORPHLET, ARKANSAS

United States Environmental Services, LLC
365 Canal Street, Suite 2500
New Orleans, Louisiana 70130
Phone: 504.527.5441

CORROSIVE LIQUID CLEANING AND PURGEING GUIDELINES

NORPHLET CHEMICAL HF PROJECT

Purpose

The purpose of this guideline is to establish safe working procedures for the cleaning and purging of tank trailers containing chemicals associated with the Norphlet Chemical site located in Norphlet, Arkansas.

Deviation

The following pages document recommended guidelines for the cleaning and purging of anhydrous hydrogen fluoride (AHF), mixtures containing AHF, sodium fluoride, chlorinated hydrocarbons and various refrigerants. Deviation from these guidelines must be approved, in writing, by the Vice President of Operations. The specific reasons for modifying the cleaning and purging operations must be explained in detail.

Guidelines Applicability

This guideline shall apply to all individuals directly involved with cleaning and purging operations.

Responsibilities

Site Supervisors and Site Safety Representatives

Project Managers, Site Supervisory personnel and Site Safety Representatives are responsible for implementing and enforcing strict compliance with the provisions of this guideline. Site safety and supervisory staff shall be knowledgeable of the constituents of concern, hazards posed by these chemicals, decontamination and emergency first aid procedures and other potential threats posed during the cleaning and purging operations. Site Supervisory personnel and Site Safety Representatives are responsible for verifying that nonessential and unprotected personnel are clear of the exclusion zone before beginning any cleaning and purging operations.

Site Personnel Directly Involved with Cleaning and Purging Operations

All site personnel are responsible for insuring that a safe working environment is maintained and that the provisions of this guideline are strictly adhered to. Site personnel will immediately notify a supervisor or safety representative of any unsafe conditions, violations of the provisions of this guideline, or defective equipment.

Safety Guidelines

1. Hold Site Specific Safety meeting with all site personnel involved at the site:

A. All cleaning and purging personnel shall be briefed on the project by the Senior Ranking Operations Manager and/or the Site Safety Representative.
B. All onsite personnel shall be briefed in accordance with Haz-Com requirements, using copies of the Site Safety Plan(s) for the project.
C. The Site Safety Plan shall be located in the Command Post during the entire project.
D. All personnel shall sign a "Safety Meeting Attendance Form" prior to starting any site operation.
E. Only those personnel essential to the cleaning and purging operation shall be present during the cleaning and purging operation. All non-essential personnel shall remain in the Support Zone or in areas pre-designated by supervisory personnel.

2. A hot zone shall be established to ensure the safety of the support personnel not directly associated with the cleaning and purging operations.

3. Before cleaning operations begin, the container(s) shall be inspected for the following:

A. Pressure
B. Capacity
C. Complete external assessment

4. Placement of wind socks:

A. One on the tank being cleaned and purged
B. One in the immediate vicinity of the cleaning and purging

6. Placement of nitrogen trailer:

A. Place on stable ground or platform
B. Maintain four (4) feet clearance between buildings, walls and any receiving vessel
C. Place nitrogen supply in an upwind position, if possible.

7. Grounding and bonding:

A. Site shall be set up in accordance with Grounding and Bonding Guidelines.

Each ground connection shall have a resistance test completed. The grounded resistance across each connection shall be no more then 0.3 ohm to be an acceptable connection.

B. For night operations, lighting equipment must be grounded to one (1) grounding rod.

8. Placement of fire extinguishers, one (1) each at:

A. Nitrogen Supply
B. Tank Trailer
C. Response Trailer

Preparations for Cleaning Operations

1. Connections and adapter inspection:

   A. Each tank trailer must have one (1) liquid line adapter with purge gas fitting and block valve and sample port, one (1) nitrogen inlet valve adapter with purge gas block valve.
   B. Each tank trailer must have one (1) vapor line adapter with purge gas fitting and block valve and sample port, one (1) nitrogen inlet valve adapter with purge gas block valve.
   C. Chemical hose shall be used for all cleaning and purging operations.
   D. Teflon gaskets shall be used for all flanged fittings and viton gaskets shall be used on all chemical hoses. Four-bolt, flanged Resistoflex brand cleaning and purging hose is equipped with built-in Teflon gaskets and do not require additional gasket materials.
   E. Inspect liquid and vapor cleaning and purging hose including flanged fittings. Check for tight bends, kinks, cuts and abrasions, and other damage or issues. Replace if necessary.
   F. Place hoses between cleaning and purging vessels with ends sealed and protected from foreign objects.
   G. Place a tool bag at the base of each tank containing equipment requisite to the construction of the cleaning and purging system.

Cleaning and Purging Operations

1. Sweep each tank trailer with Nitrogen into scrubber system located onsite until free of all traces of HF vapors. Check at sample port in vapor line to ensure adequate purging has occurred. Continue vapor line connection with scrubber system until fill is complete.

2. Solution Mixture Specification- Utilizing a mix tank, add hydrated lime ($Ca(OH)_2$) and water together to make a solution. Agitate the mixture with an air compressor to ensure total saturation of available hydrated lime ($Ca(OH)_2$). Draw the solution off the top of the tank and place this solution into a storage vessel.

3. Fill tank trailer 1/3 full rapidly with water to remove any contaminates left. Remove water to additional tank.

4. Introduce the caustic solution of hydrated lime ($Ca(OH)_2$) into the tank trailer. Continue to fill the tank nearly shell full and allow to sit 8 hours. The pH level should be monitored approximately every 2 hours to ensure that the interior of the tank continuously maintains a pH of 12-13.

5. After the 8 hour period ensure the pH of the solution is at least 8.0. If the pH is above 8.0, then tank is free of HF. If it is not then adjust the pH by adding additional lime water solution. Allow this solution to sit an additional 2 hours.

6. Removed solution and wash interior with water.

7. Access interior of tank trailer. Visually inspect all surfaces for residual hydrated lime and precipitate. If any residues are found, spot wash with water.

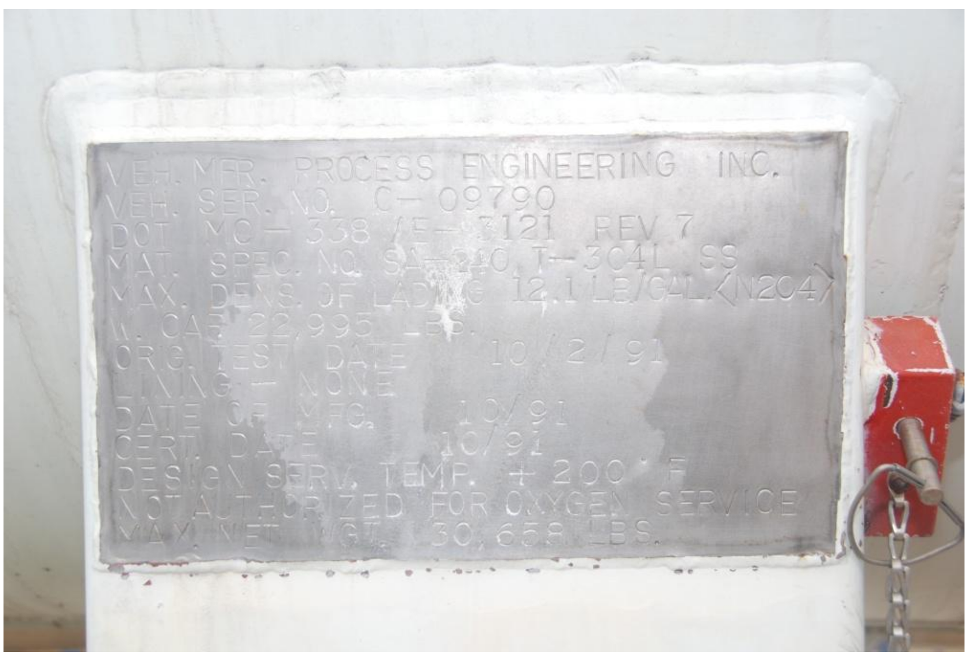
8. Dry using forced-air heat.

9. Each tank trailer will need 2 wipe samples taken: one at the front of the tank and the other at the rear. The samples would be analyzed for pH, total fluorides, and total TCE (trichloroethylene). If the pH ranges from 6-8 and less than 10ppm fluorides and TCE, this ensures tank trailer has been properly decontaminated.

10. Coordinate with onsite EPA Representatives for disposal of liquid wastes.

APPENDIX B. PHOTOGRAPHS OF INSPECTED TRAILERS

Photograph 1 Trailer 807 Serial No. C-09790

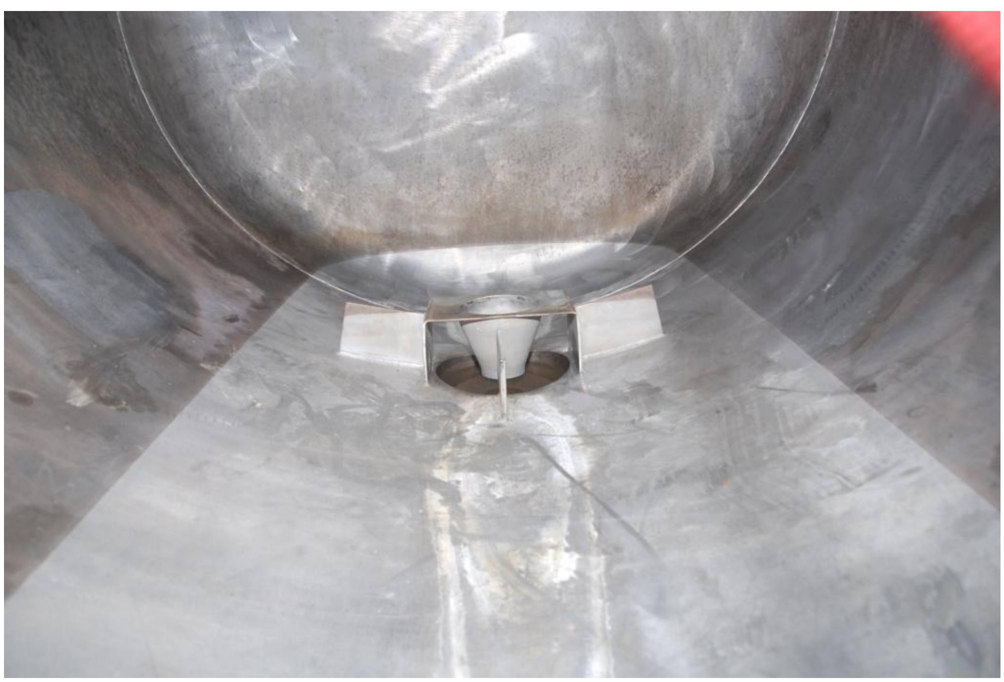


Photograph 2 Trailer 807 Serial No. C-09790

Photograph 3 Trailer 807 Serial No. C-09790

Photograph 4 Trailer 807 Serial No. C-09790

Photograph 5 Trailer 807 Serial No. C-09790



Photograph 6 Trailer 807 Serial No. C-09790

Photograph 7 Trailer 805 Serial No. C-09590

Photograph 8 Trailer 805 Serial No. C-09590

Photograph 9 Trailer 805 Serial No. C-09590

Photograph 10 Trailer 805 Serial No. C-09590

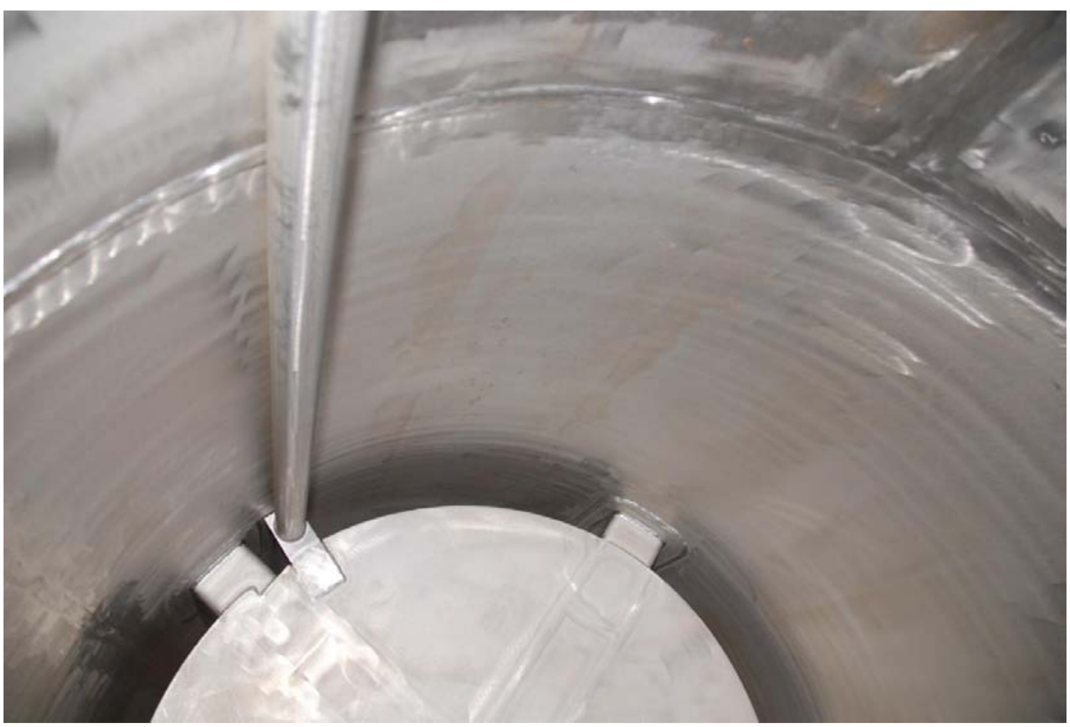
Photograph 11 Trailer 805 Serial No. C-09590

Photograph 12 Trailer 805 Serial No. C-09590

Photograph 13 Trailer 810 Serial No. C-10090

Photograph 14 Trailer 810 Serial No. C-10090

Photograph 15 Trailer 810 Serial No. C-10090



Photograph 16 Trailer 810 Serial No. C-10090

Photograph 17 Trailer 803 Serial No. C-09390

Photograph 18 Trailer 803 Serial No. C-09390

Photograph 19 Trailer 803 Serial No. C-09390

Photograph 20 Trailer 803 Serial No. C-09390

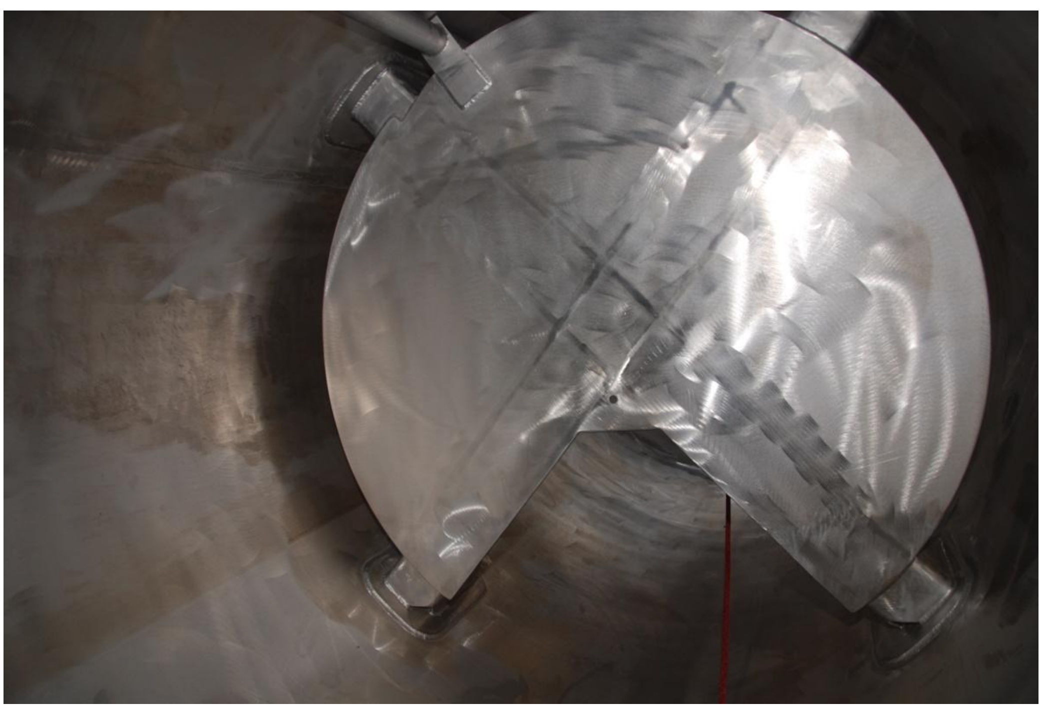
Photograph 21 Trailer 803 Serial No. C-09390

Photograph 21 Trailer 803 Serial No. C-09390

Photograph 22 Trailer 804 Serial No. C-09490

Photograph 23 Trailer 804 Serial No. C-09490

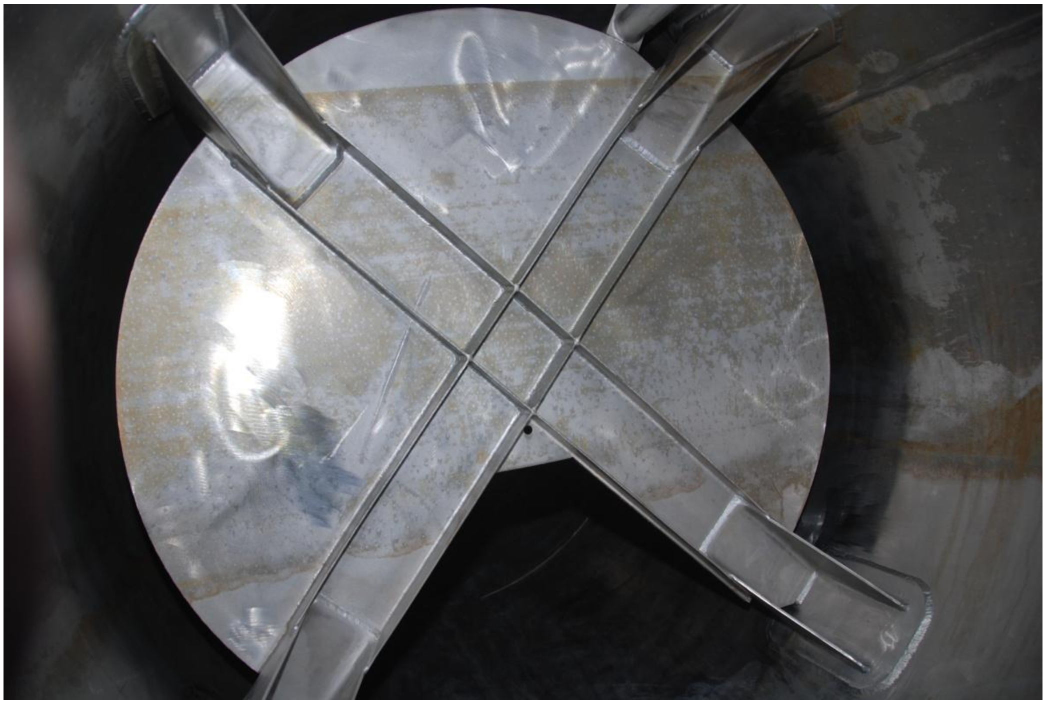
Photograph 24 Trailer 804 Serial No. C-09490



Photograph 25 Trailer 804 Serial No. C-09490

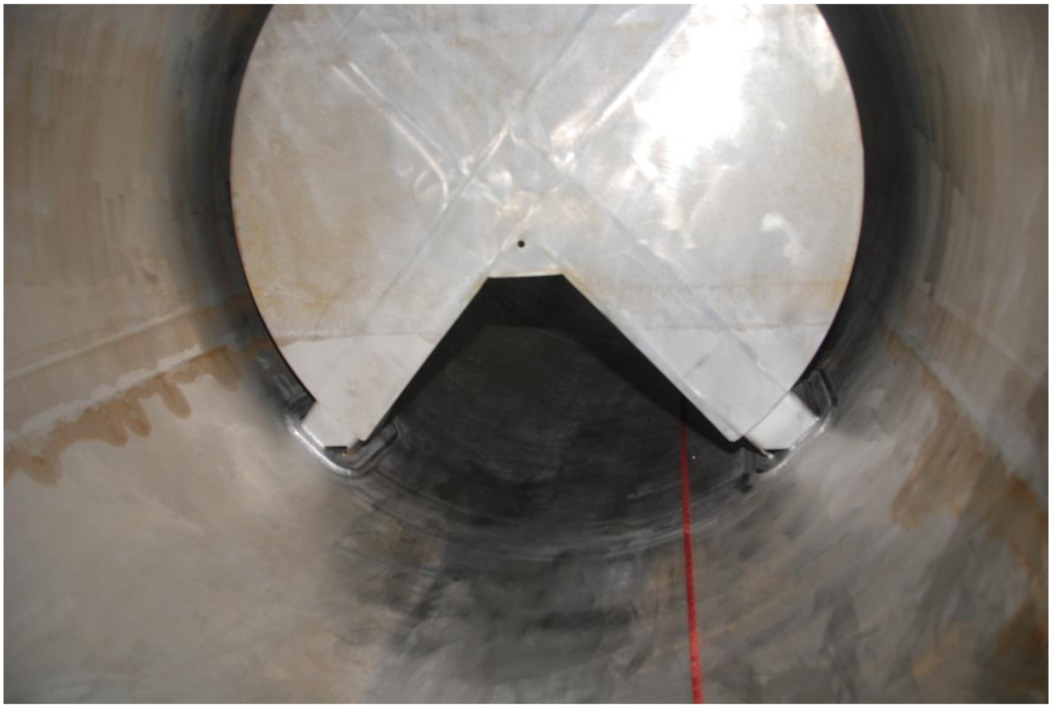
Photograph 26 Trailer 809 Serial No. C-0990

Photograph 26 Trailer 809 Serial No. C-0990



Photograph 27 Trailer 809 Serial No. C-0990

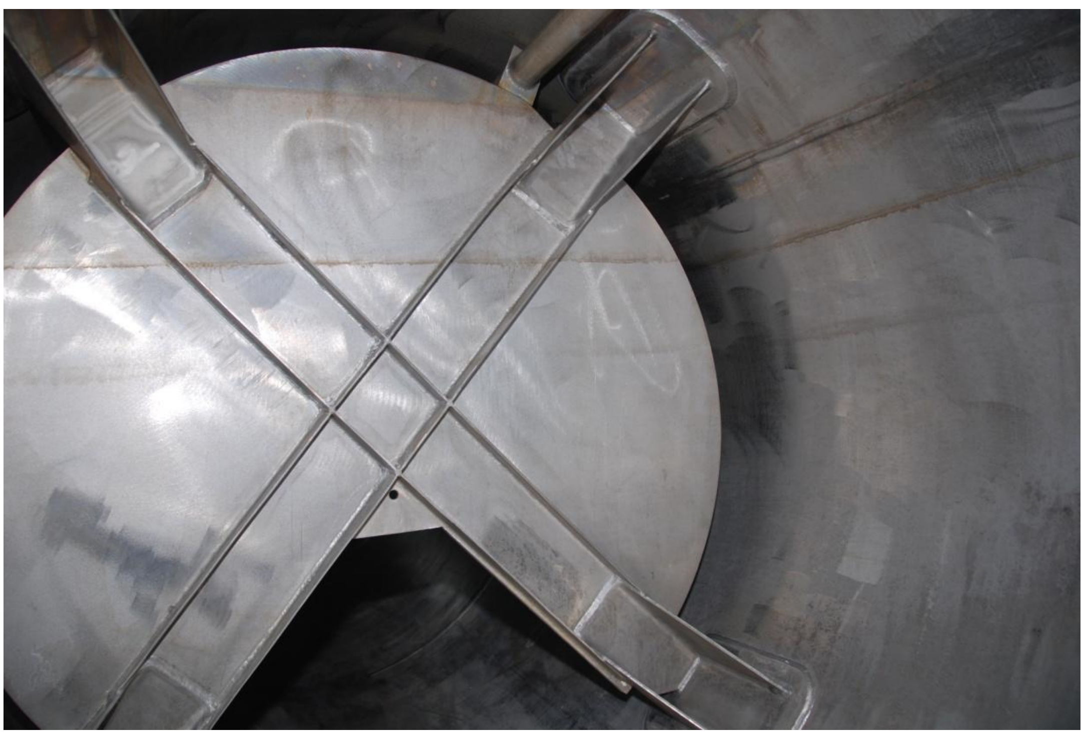
Photograph 28 Trailer 809 Serial No. C-0990



Photograph 29 Trailer 809 Serial No. C-0990

Photograph 30 Trailer 808 Serial No. C-09890

Photograph 31 Trailer 808 Serial No. C-09890



Photograph 32 Trailer 808 Serial No. C-09890

Photograph 33 Trailer 808 Serial No. C-09890

Photograph 34 Trailer 808 Serial No. C-09890

Photograph 35 Trailer 1190 Serial No. STE-6065

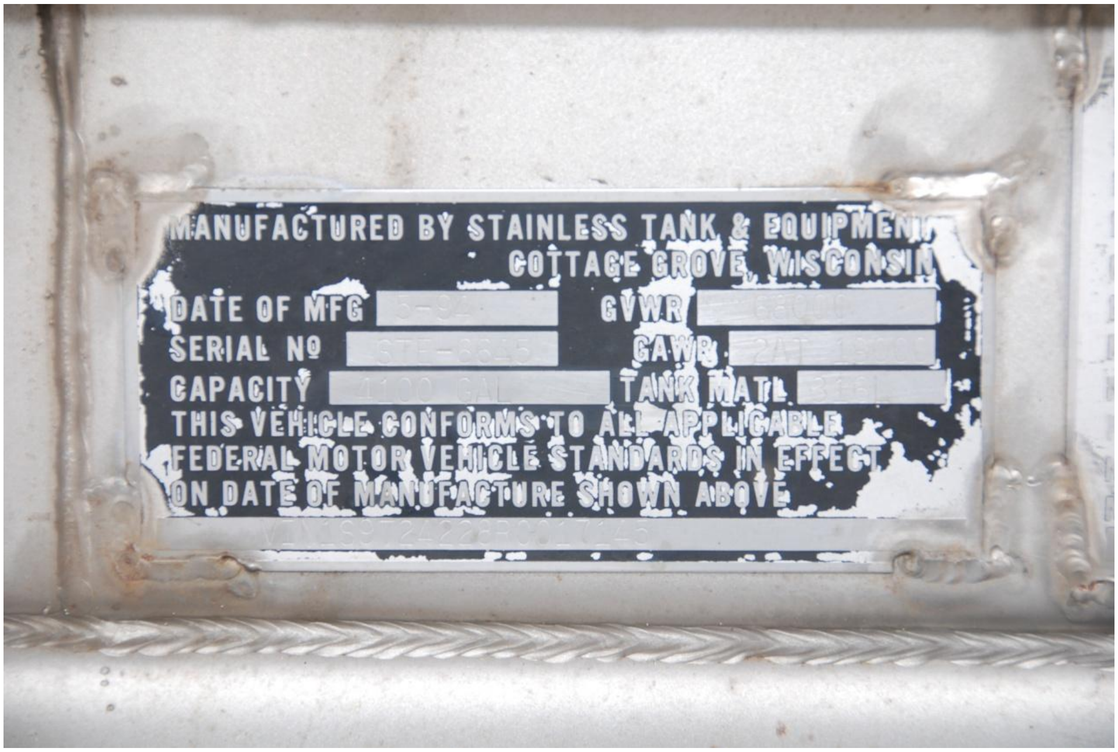
Photograph 36 Trailer 1190 Serial No. STE-6065

Photograph 37 Trailer 1190 Serial No. STE-6065

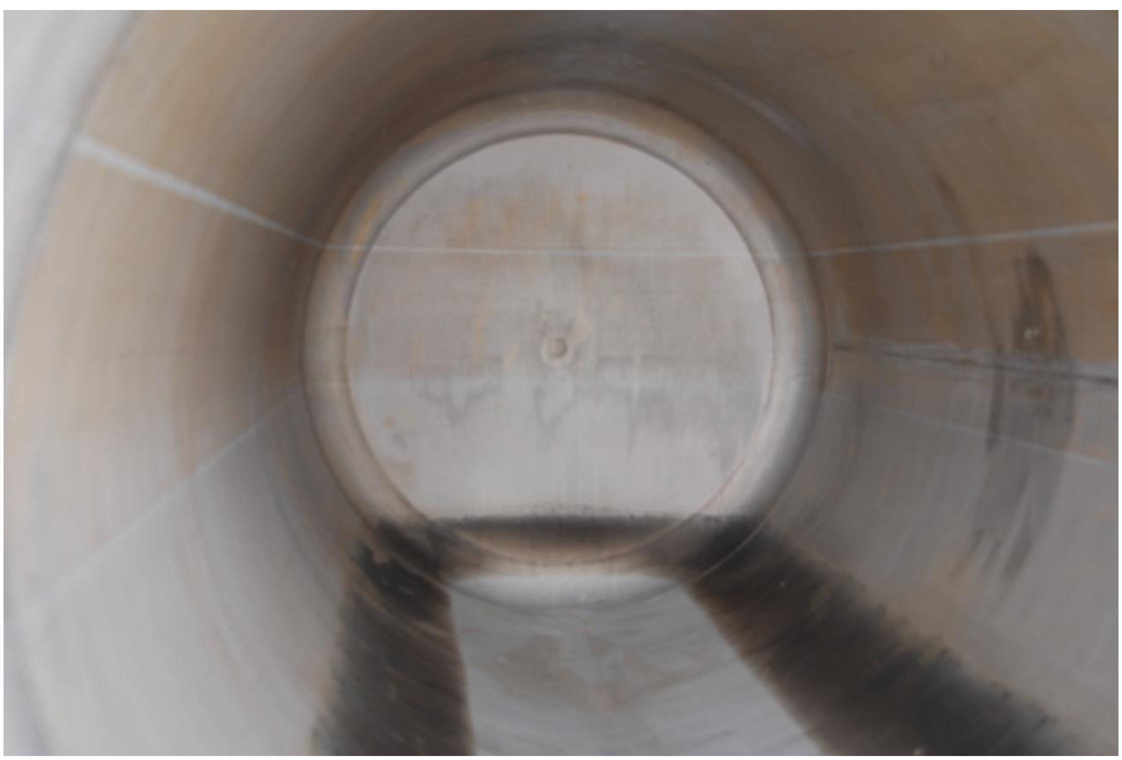
Photograph 38 Trailer 1190 Serial No. STE-6065

Photograph 39 Trailer 1190 Serial No. STE-6065

Photograph 40 Trailer 1303 Serial No. STE-6645



Photograph 41 Trailer 1303 Serial No. STE-6645



Photograph 42 Trailer 1303 Serial No. STE-6645

Photograph 43 Trailer 1303 Serial No. STE-6645

Photograph 44 Trailer 1303 Serial No. STE-6645

APPENDIX C. ULTRASONIC READINGS TAKEN BY ALL TECH PERSONNEL

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: K803 Serial #: 9461

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
K803	Center	Front Head	0.547"	
K803	12:00	Front Head	0.577"	
K803	3:00	Front Head	0.578"	
K803	6:00	Front Head	0.583"	
K803	9:00	Front Head	0.583"	
K803	12:00	1"	0.422"	
K803	3:00	1"	0.433"	
K803	6:00	1"	0.423"	
K803	9:00	1"	0.425"	
K803	12:00	2'	0.430"	
K803	3:00	2'	0.436"	
K803	6:00	2'	0.433"	
K803	9:00	2'	0.431"	
K803	12:00	4'	0.432"	
K803	3:00	4'	0.440"	
K803	6:00	4'	0.441"	
K803	9:00	4'	0.433"	
K803	12:00	6'	0.432"	
K803	3:00	6'	0.442"	
K803	6:00	6'	0.437"	
K803	9:00	6'	0.434"	
K803	12:00	8'	0.428"	
K803	3:00	8'	0.436"	
K803	6:00	8'	0.435"	
K803	9:00	8'	0.434"	
K803	12:00	10'	0.429"	
K803	3:00	10'	0.428"	
K803	6:00	10'	0.426"	
K803	9:00	10'	0.431"	
K803	12:00	12'	0.430"	
K803	3:00	12'	0.435"	
K803	6:00	12'	0.428"	
K803	9:00	12'	0.430"	
K803	12:00	14'	0.430"	
K803	3:00	14'	0.430"	
K803	6:00	14'	0.431"	
K803	9:00	14'	0.433"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: K803 Serial #: 9461

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
K810	12:00	16'	0.429"	
K810	3:00	16'	0.431"	
K810	6:00	16'	0.429"	
K810	9:00	16'	0.430"	
K810	12:00	18'	0.424"	
K810	3:00	18'	0.424"	
K810	6:00	18'	0.426"	
K810	9:00	18'	0.422"	
K810	12:00	20'	0.443"	
K810	3:00	20'	0.438"	
K810	6:00	20'	0.438"	
K810	9:00	20'	0.443"	
K810	12:00	22'	0.449"	
K810	3:00	22'	0.440"	
K810	6:00	22'	0.441"	
K810	9:00	22'	0.441"	
K810	12:00	24'	0.446"	
K810	3:00	24'	0.438"	
K810	6:00	24'	0.438"	
K810	9:00	24'	0.437"	
K810	12:00	26'	N/A	Manway
K810	3:00	26'	0.434"	
K810	6:00	26'	0.438"	
K810	9:00	26'	0.434"	
K810	12:00	1"	0.436"	
K810	3:00	1"	0.426"	
K810	6:00	1"	0.425"	
K810	9:00	1"	0.431"	
K810	Center	Back Head	0.442"	
K810	12:00	Back Head	0.482"	
K810	3:00	Back Head	0.477"	
K810	6:00	Back Head	0.478"	
K810	9:00	Back Head	0.479"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: K804 Serial #: 9475

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
K804	Center	Front Head	0.530"	
K804	12:00	Front Head	0.538"	
K804	3:00	Front Head	0.531"	
K804	6:00	Front Head	0.533"	
K804	9:00	Front Head	0.538"	
K804	12:00	1"	0.434"	
K804	3:00	1"	0.428"	
K804	6:00	1"	0.431"	
K804	9:00	1"	0.426"	
K804	12:00	2'	0.438"	
K804	3:00	2'	0.438"	
K804	6:00	2'	0.439"	
K804	9:00	2'	0.431"	
K804	12:00	4'	0.438"	
K804	3:00	4'	0.440"	
K804	6:00	4'	0.439"	
K804	9:00	4'	0.433"	
K804	12:00	6'	0.439"	
K804	3:00	6'	0.434"	
K804	6:00	6'	0.443"	
K804	9:00	6'	0.431"	
K804	12:00	8'	0.429"	
K804	3:00	8'	0.433"	
K804	6:00	8'	0.437"	
K804	9:00	8'	0.431"	
K804	12:00	10'	0.438"	
K804	3:00	10'	0.431"	
K804	6:00	10'	0.429"	
K804	9:00	10'	0.432"	
K804	12:00	12'	0.440"	
K804	3:00	12'	0.439"	
K804	6:00	12'	0.437"	
K804	9:00	12'	0.436"	
K804	12:00	14'	0.440"	
K804	3:00	14'	0.440"	
K804	6:00	14'	0.438"	
K804	9:00	14'	0.436"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: K804 Serial #: 9475

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
K804	12:00	16'	0.439"	
K804	3:00	16'	0.434"	
K804	6:00	16'	0.433"	
K804	9:00	16'	0.436"	
K804	12:00	18'	0.432"	
K804	3:00	18'	0.429"	
K804	6:00	18'	0.426"	
K804	9:00	18'	0.430"	
K804	12:00	20'	0.449"	
K804	3:00	20'	0.444"	
K804	6:00	20'	0.443"	
K804	9:00	20'	0.443"	
K804	12:00	22'	0.447"	
K804	3:00	22'	0.443"	
K804	6:00	22'	0.442"	
K804	9:00	22'	0.443"	
K804	12:00	24'	0.449"	
K804	3:00	24'	0.447"	
K804	6:00	24'	0.443"	
K804	9:00	24'	0.445"	
K804	12:00	26'	N/A	Manway
K804	3:00	26'	0.444"	
K804	6:00	26'	0.448"	
K804	9:00	26'	0.441"	
K804	12:00	1"	0.446"	
K804	3:00	1"	0.437"	
K804	6:00	1"	0.439"	
K804	9:00	1"	0.440"	
K804	Center	Back Head	0.432"	
K804	12:00	Back Head	0.471"	
K804	3:00	Back Head	0.481"	
K804	6:00	Back Head	0.468"	
K804	9:00	Back Head	0.511"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: K805 Serial #: 09590

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
K805	Center	Front Head	0.545"	
K805	12:00	Front Head	0.577"	
K805	3:00	Front Head	0.598"	
K805	6:00	Front Head	0.610"	
K805	9:00	Front Head	0.586"	
K805	12:00	1"	0.444"	
K805	3:00	1"	0.442"	
K805	6:00	1"	0.446"	
K805	9:00	1"	0.443"	
K805	12:00	2'	0.452"	
K805	3:00	2'	0.455"	
K805	6:00	2'	0.453"	
K805	9:00	2'	0.448"	
K805	12:00	4'	0.455"	
K805	3:00	4'	0.456"	
K805	6:00	4'	0.456"	
K805	9:00	4'	0.454"	
K805	12:00	6'	0.455"	
K805	3:00	6'	0.458"	
K805	6:00	6'	0.455"	
K805	9:00	6'	0.454"	
K805	12:00	8'	0.452"	
K805	3:00	8'	0.455"	
K805	6:00	8'	0.451"	
K805	9:00	8'	0.451"	
K805	12:00	10'	0.446"	
K805	3:00	10'	0.444"	
K805	6:00	10'	0.450"	
K805	9:00	10'	0.449"	
K805	12:00	12'	0.454"	
K805	3:00	12'	0.451"	
K805	6:00	12'	0.457"	
K805	9:00	12'	0.454"	
K805	12:00	14'	0.455"	
K805	3:00	14'	0.457"	
K805	6:00	14'	0.454"	
K805	9:00	14'	0.457"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: Jacob Hatchett

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: K805 **Serial #: 9586**

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
K805	12:00	16'	0.450"	
K805	3:00	16'	0.449"	
K805	6:00	16'	0.457"	
K805	9:00	16'	0.451"	
K805	12:00	18'	0.435"	
K805	3:00	18'	0.434"	
K805	6:00	18'	0.442"	
K805	9:00	18'	0.439	
K805	12:00	20'	0.455"	
K805	3:00	20'	0.449"	
K805	6:00	20'	0.453"	
K805	9:00	20'	0.454"	
K805	12:00	22'	0.455"	
K805	3:00	22'	0.451"	
K805	6:00	22'	0.456"	
K805	9:00	22'	0.454"	
K805	12:00	24'	0.455"	
K805	3:00	24'	0.451"	
K805	6:00	24'	0.454"	
K805	9:00	24'	0.454"	
K805	12:00	26'	N/A	Manway
K805	3:00	26'	0.449"	
K805	6:00	26'	0.455"	
K805	9:00	26'	0.454"	
K805	12:00	1"	0.443"	
K805	3:00	1"	0.444"	
K805	6:00	1"	0.443"	
K805	9:00	1"	0.447"	
K805	Center	Back Head	0.437"	
K805	12:00	Back Head	0.481"	
K805	3:00	Back Head	0.485"	
K805	6:00	Back Head	0.484"	
K805	9:00	Back Head	0.475"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett **Level:** II **Signature:** *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: K807 Serial #: 9586

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
K807	Center	Front Head	0.551"	
K807	12:00	Front Head	0.628"	
K807	3:00	Front Head	0.606"	
K807	6:00	Front Head	0.598"	
K807	9:00	Front Head	0.595"	
K807	12:00	1"	0.427"	
K807	3:00	1"	0.431"	
K807	6:00	1"	0.434"	
K807	9:00	1"	0.432"	
K807	12:00	2'	0.447"	
K807	3:00	2'	0.447"	
K807	6:00	2'	0.445"	
K807	9:00	2'	0.445"	
K807	12:00	4'	0.453"	
K807	3:00	4'	0.451"	
K807	6:00	4'	0.453"	
K807	9:00	4'	0.451"	
K807	12:00	6'	0.450"	
K807	3:00	6'	0.449"	
K807	6:00	6'	0.459"	
K807	9:00	6'	0.449"	
K807	12:00	8'	0.438"	
K807	3:00	8'	0.440"	
K807	6:00	8'	0.440"	
K807	9:00	8'	0.438"	
K807	12:00	10'	0.438"	
K807	3:00	10'	0.439"	
K807	6:00	10'	0.441"	
K807	9:00	10'	0.437"	
K807	12:00	12'	0.452"	
K807	3:00	12'	0.448"	
K807	6:00	12'	0.445"	
K807	9:00	12'	0.446"	
K807	12:00	14'	0.449"	
K807	3:00	14'	0.451"	
K807	6:00	14'	0.451"	
K807	9:00	14'	0.451"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: K807 Serial #: 9586

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
K807	12:00	16'	0.551"	
K807	3:00	16'	0.628"	
K807	6:00	16'	0.606"	
K807	9:00	16'	0.598"	
K807	12:00	18'	0.595"	
K807	3:00	18'	0.427"	
K807	6:00	18'	0.431"	
K807	9:00	18'	0.434"	
K807	12:00	20'	0.432"	
K807	3:00	20'	0.447"	
K807	6:00	20'	0.447"	
K807	9:00	20'	0.445"	
K807	12:00	22'	0.445"	
K807	3:00	22'	0.453"	
K807	6:00	22'	0.451"	
K807	9:00	22'	0.453"	
K807	12:00	24'	0.451"	
K807	3:00	24'	0.450"	
K807	6:00	24'	0.449"	
K807	9:00	24'	0.450"	
K807	12:00	26'	N/A	Manway
K807	3:00	26'	0.438"	
K807	6:00	26'	0.440"	
K807	9:00	26'	0.440"	
K807	12:00	1"	0.438"	
K807	3:00	1"	0.438"	
K807	6:00	1"	0.439"	
K807	9:00	1"	0.440"	
K807	Center	Back Head	0.437"	
K807	12:00	Back Head	0.452"	
K807	3:00	Back Head	0.448"	
K807	6:00	Back Head	0.445"	
K807	9:00	Back Head	0.446"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: K808 Serial #: 9596

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
K808	Center	Front Head	0.546"	
K808	12:00	Front Head	0.578"	
K808	3:00	Front Head	0.603"	
K808	6:00	Front Head	0.608"	
K808	9:00	Front Head	0.595"	
K808	12:00	1"	0.428"	
K808	3:00	1"	0.431"	
K808	6:00	1"	0.430"	
K808	9:00	1"	0.427"	
K808	12:00	2'	0.441"	
K808	3:00	2'	0.447"	
K808	6:00	2'	0.445"	
K808	9:00	2'	0.441"	
K808	12:00	4'	0.448"	
K808	3:00	4'	0.450"	
K808	6:00	4'	0.448"	
K808	9:00	4'	0.446"	
K808	12:00	6'	0.445"	
K808	3:00	6'	0.446"	
K808	6:00	6'	0.445"	
K808	9:00	6'	0.444"	
K808	12:00	8'	0.432"	
K808	3:00	8'	0.431"	
K808	6:00	8'	0.434"	
K808	9:00	8'	0.431"	
K808	12:00	10'	0.444"	
K808	3:00	10'	0.438"	
K808	6:00	10'	0.439"	
K808	9:00	10'	0.437"	
K808	12:00	12'	0.452"	
K808	3:00	12'	0.446"	
K808	6:00	12'	0.446"	
K808	9:00	12'	0.448"	
K808	12:00	14'	0.454"	
K808	3:00	14'	0.448"	
K808	6:00	14'	0.452"	
K808	9:00	14'	0.451"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: K808 **Serial #: 9596**

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
K808	12:00	16'	0.447"	
K808	3:00	16'	0.445"	
K808	6:00	16'	0.447"	
K808	9:00	16'	0.446"	
K808	12:00	18'	0.434"	
K808	3:00	18'	0.430"	
K808	6:00	18'	0.438"	
K808	9:00	18'	0.434"	
K808	12:00	20'	0.446"	
K808	3:00	20'	0.443"	
K808	6:00	20'	0.444"	
K808	9:00	20'	0.442"	
K808	12:00	22'	0.456"	
K808	3:00	22'	0.448"	
K808	6:00	22'	0.447"	
K808	9:00	22'	0.451"	
K808	12:00	24'	0.450"	
K808	3:00	24'	0.449"	
K808	6:00	24'	0.447"	
K808	9:00	24'	0.446"	
K808	12:00	26'	N/A	Manway
K808	3:00	26'	0.445"	
K808	6:00	26'	0.438"	
K808	9:00	26'	0.440"	
K808	12:00	1"	0.422"	
K808	3:00	1"	0.430"	
K808	6:00	1"	0.427"	
K808	9:00	1"	0.427"	
K808	Center	Back Head	0.435"	
K808	12:00	Back Head	0.490"	
K808	3:00	Back Head	0.501"	
K808	6:00	Back Head	0.501"	
K808	9:00	Back Head	0.482"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: K809 Serial #: 9631

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
K809	Center	Front Head	0.540"	
K809	12:00	Front Head	0.616"	
K809	3:00	Front Head	0.599"	
K809	6:00	Front Head	0.601"	
K809	9:00	Front Head	0.628"	
K809	12:00	1"	0.431"	
K809	3:00	1"	0.436"	
K809	6:00	1"	0.433"	
K809	9:00	1"	0.433"	
K809	12:00	2'	0.447"	
K809	3:00	2'	0.443"	
K809	6:00	2'	0.442"	
K809	9:00	2'	0.443"	
K809	12:00	4'	0.445"	
K809	3:00	4'	0.449"	
K809	6:00	4'	0.445"	
K809	9:00	4'	0.447"	
K809	12:00	6'	0.445"	
K809	3:00	6'	0.444"	
K809	6:00	6'	0.448"	
K809	9:00	6'	0.446"	
K809	12:00	8'	0.436"	
K809	3:00	8'	0.441"	
K809	6:00	8'	0.440"	
K809	9:00	8'	0.442"	
K809	12:00	10'	0.437"	
K809	3:00	10'	0.439"	
K809	6:00	10'	0.438"	
K809	9:00	10'	0.441"	
K809	12:00	12'	0.440"	
K809	3:00	12'	0.443"	
K809	6:00	12'	0.439"	
K809	9:00	12'	0.444"	
K809	12:00	14'	0.442"	
K809	3:00	14'	0.445"	
K809	6:00	14'	0.441"	
K809	9:00	14'	0.446"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: Jacob Hatchett

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: K809 Serial #: 9631

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
K809	12:00	16'	0.426"	
K809	3:00	16'	0.428"	
K809	6:00	16'	0.428"	
K809	9:00	16'	0.430"	
K809	12:00	18'	0.443"	
K809	3:00	18'	0.439"	
K809	6:00	18'	0.438"	
K809	9:00	18'	0.443"	
K809	12:00	20'	0.444"	
K809	3:00	20'	0.443"	
K809	6:00	20'	0.439"	
K809	9:00	20'	0.442"	
K809	12:00	22'	0.444"	
K809	3:00	22'	0.442"	
K809	6:00	22'	0.438"	
K809	9:00	22'	0.445"	
K809	12:00	24'	0.431"	
K809	3:00	24'	0.440"	
K809	6:00	24'	0.436"	
K809	9:00	24'	0.441"	
K809	12:00	26'	N/A	Manway
K809	3:00	26'	0.439"	
K809	6:00	26'	0.441"	
K809	9:00	26'	0.440"	
K809	12:00	1"	0.434"	
K809	3:00	1"	0.426"	
K809	6:00	1"	0.429"	
K809	9:00	1"	0.429"	
K809	Center	Back Head	0.500"	
K809	12:00	Back Head	0.512"	
K809	3:00	Back Head	0.515"	
K809	6:00	Back Head	0.499"	
K809	9:00	Back Head	0.438"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: K810 Serial #: 9643

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
K810	Center	Front Head	0.529"	
K810	12:00	Front Head	0.592"	
K810	3:00	Front Head	0.613"	
K810	6:00	Front Head	0.613"	
K810	9:00	Front Head	0.589"	
K810	12:00	1"	0.436"	
K810	3:00	1"	0.435"	
K810	6:00	1"	0.434"	
K810	9:00	1"	0.436"	
K810	12:00	2'	0.446"	
K810	3:00	2'	0.446"	
K810	6:00	2'	0.443"	
K810	9:00	2'	0.450"	
K810	12:00	4'	0.450"	
K810	3:00	4'	0.448"	
K810	6:00	4'	0.444"	
K810	9:00	4'	0.452"	
K810	12:00	6'	0.448"	
K810	3:00	6'	0.449"	
K810	6:00	6'	0.446"	
K810	9:00	6'	0.451"	
K810	12:00	8'	0.444"	
K810	3:00	8'	0.445"	
K810	6:00	8'	0.444"	
K810	9:00	8'	0.450"	
K810	12:00	10'	0.444"	
K810	3:00	10'	0.446"	
K810	6:00	10'	0.445"	
K810	9:00	10'	0.447"	
K810	12:00	12'	0.447"	
K810	3:00	12'	0.454"	
K810	6:00	12'	0.449"	
K810	9:00	12'	0.455"	
K810	12:00	14'	0.453"	
K810	3:00	14'	0.452"	
K810	6:00	14'	0.448"	
K810	9:00	14'	0.457"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: Jacob Hatchett

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: K810 Serial #: 9643

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
K810	12:00	16'	0.443"	
K810	3:00	16'	0.449"	
K810	6:00	16'	0.447"	
K810	9:00	16'	0.451"	
K810	12:00	18'	0.435"	
K810	3:00	18'	0.438"	
K810	6:00	18'	0.436"	
K810	9:00	18'	0.438"	
K810	12:00	20'	0.438"	
K810	3:00	20'	0.443"	
K810	6:00	20'	0.445"	
K810	9:00	20'	0.446"	
K810	12:00	22'	0.445"	
K810	3:00	22'	0.441"	
K810	6:00	22'	0.447"	
K810	9:00	22'	0.449"	
K810	12:00	24'	0.447"	
K810	3:00	24'	0.444"	
K810	6:00	24'	0.446"	
K810	9:00	24'	0.447"	
K810	12:00	26'	N/A	Manway
K810	3:00	26'	0.445"	
K810	6:00	26'	0.443"	
K810	9:00	26'	0.442"	
K810	12:00	1"	0.435"	
K810	3:00	1"	0.435"	
K810	6:00	1"	0.431"	
K810	9:00	1"	0.429"	
K810	Center	Back Head	0.441"	
K810	12:00	Back Head	0.479"	
K810	3:00	Back Head	0.471"	
K810	6:00	Back Head	0.478"	
K810	9:00	Back Head	0.491"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: 1190 **Serial #:** STE-6056

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
1190	Center	Front Head	0.351"	
1190	12:00	Front Head	0.369"	
1190	3:00	Front Head	0.370"	
1190	6:00	Front Head	0.368"	
1190	9:00	Front Head	0.371"	
1190	12:00	1"	0.301"	
1190	3:00	1"	0.300"	
1190	6:00	1"	0.296"	
1190	9:00	1"	0.300"	
1190	12:00	2'	0.306"	
1190	3:00	2'	0.303"	
1190	6:00	2'	0.306"	
1190	9:00	2'	0.305"	
1190	12:00	4'	0.308"	
1190	3:00	4'	0.307"	
1190	6:00	4'	0.309"	
1190	9:00	4'	0.308"	
1190	12:00	6'	0.306"	
1190	3:00	6'	0.306"	
1190	6:00	6'	0.307"	
1190	9:00	6'	0.306"	
1190	12:00	8'	0.310"	
1190	3:00	8'	0.305"	
1190	6:00	8'	0.308"	
1190	9:00	8'	0.308"	
1190	12:00	10'	0.314"	
1190	3:00	10'	0.315"	
1190	6:00	10'	0.317"	
1190	9:00	10'	0.317"	
1190	12:00	12'	0.318"	
1190	3:00	12'	0.317"	
1190	6:00	12'	0.319"	
1190	9:00	12'	0.319"	
1190	12:00	14'	0.316"	
1190	3:00	14'	0.314"	
1190	6:00	14'	0.313"	
1190	9:00	14'	0.315"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett **Level:** II **Signature:** *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: 1190 Serial #: STE-6056

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
1190	12:00	16'	0.315"	
1190	3:00	16'	0.313"	
1190	6:00	16'	0.308"	
1190	9:00	16'	0.311"	
1190	12:00	18'	0.323"	
1190	3:00	18'	0.325"	
1190	6:00	18'	0.317"	
1190	9:00	18'	0.319"	
1190	12:00	20'	0.322"	
1190	3:00	20'	0.325"	
1190	6:00	20'	0.318"	
1190	9:00	20'	0.319"	
1190	12:00	22'	0.322"	
1190	3:00	22'	0.323"	
1190	6:00	22'	0.313"	
1190	9:00	22'	0.317"	
1190	12:00	24'	0.309"	
1190	3:00	24'	0.308"	
1190	6:00	24'	0.306"	
1190	9:00	24'	0.309"	
1190	12:00	26'	0.315"	
1190	3:00	26'	0.316"	
1190	6:00	26'	0.313"	
1190	9:00	26'	0.317"	
1190	12:00	28'	0.315"	
1190	3:00	28'	0.313"	
1190	6:00	28'	0.314"	
1190	9:00	28'	0.317"	
1190	12:00	30'	0.312"	
1190	3:00	30'	0.312"	
1190	6:00	30'	0.311"	
1190	9:00	30'	0.314"	
1190	12:00	32'	0.313"	
1190	3:00	32'	0.297"	
1190	6:00	32'	0.314"	
1190	9:00	32'	0.304"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: 1190 Serial #: STE-6056

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
1190	12:00	34'	0.320"	
1190	3:00	34'	0.305"	
1190	6:00	34'	0.311"	
1190	9:00	34'	0.319"	
1190	12:00	36'	N/A	Manway
1190	3:00	36'	0.309"	
1190	6:00	36'	0.312"	
1190	9:00	36'	0.317"	
1190	12:00	1"	0.314"	
1190	3:00	1"	0.302"	
1190	6:00	1"	0.308"	
1190	9:00	1"	0.312"	
1190	Center	Back Head	0.352"	
1190	12:00	Back Head	0.370"	
1190	3:00	Back Head	0.373"	
1190	6:00	Back Head	0.370"	
1190	9:00	Back Head	0.379"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: Jacob Hatchett

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: 1303 Serial #: STF-6645

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
1303	Center	Front Head	0.369"	
1303	12:00	Front Head	0.389"	
1303	3:00	Front Head	0.398"	
1303	6:00	Front Head	0.368"	
1303	9:00	Front Head	0.395"	
1303	12:00	1"	0.309"	
1303	3:00	1"	0.309"	
1303	6:00	1"	0.307"	
1303	9:00	1"	0.307"	
1303	12:00	2'	0.310"	
1303	3:00	2'	0.309"	
1303	6:00	2'	0.310"	
1303	9:00	2'	0.310"	
1303	12:00	4'	0.313"	
1303	3:00	4'	0.313"	
1303	6:00	4'	0.308"	
1303	9:00	4'	0.313"	
1303	12:00	6'	0.313"	
1303	3:00	6'	0.310"	
1303	6:00	6'	0.306"	
1303	9:00	6'	0.307"	
1303	12:00	8'	0.319"	
1303	3:00	8'	0.325"	
1303	6:00	8'	0.321"	
1303	9:00	8'	0.319"	
1303	12:00	10'	0.316"	
1303	3:00	10'	0.318"	
1303	6:00	10'	0.321"	
1303	9:00	10'	0.319"	
1303	12:00	12'	0.317"	
1303	3:00	12'	0.313"	
1303	6:00	12'	0.318"	
1303	9:00	12'	0.318"	
1303	12:00	14'	0.319"	
1303	3:00	14'	0.321"	
1303	6:00	14'	0.320"	
1303	9:00	14'	0.319"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: 1303 Serial #: STF-6645

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
1303	12:00	16'	0.327"	
1303	3:00	16'	0.325"	
1303	6:00	16'	0.326"	
1303	9:00	16'	0.326"	
1303	12:00	18'	0.328"	
1303	3:00	18'	0.331"	
1303	6:00	18'	0.331"	
1303	9:00	18'	0.328"	
1303	12:00	20'	0.327"	
1303	3:00	20'	0.331"	
1303	6:00	20'	0.328"	
1303	9:00	20'	0.329"	
1303	12:00	22'	0.323"	
1303	3:00	22'	0.326"	
1303	6:00	22'	0.325"	
1303	9:00	22'	0.326"	
1303	12:00	24'	0.327"	
1303	3:00	24'	0.326"	
1303	6:00	24'	0.328"	
1303	9:00	24'	0.318"	
1303	12:00	26'	0.333"	
1303	3:00	26'	0.334"	
1303	6:00	26'	0.334"	
1303	9:00	26'	0.322"	
1303	12:00	28'	0.327"	
1303	3:00	28'	0.331"	
1303	6:00	28'	0.333"	
1303	9:00	28'	0.322"	
1303	12:00	30'	0.319"	
1303	3:00	30'	0.324"	
1303	6:00	30'	0.325"	
1303	9:00	30'	0.314"	
1303	12:00	32'	0.336"	
1303	3:00	32'	0.332"	
1303	6:00	32'	0.333"	
1303	9:00	32'	0.334"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

Name: Jacob Hatchett Level: II Signature: *Jacob Hatchett*

TML Readings Data Report

ALL TECH INSPECTION

Date:	9/3/2009
Name:	Jacob Hatchett/Level II
Equipment:	Panametrics 37DL+ S/N# 081632208
Transducer:	D790-SM 5 MHz S/N# 643714
Cal Block:	ATI Cal Block S/N# 08-7174
Couplant:	Sonoglide Batch# 45-T04 09129

Unit#: 1303   Serial #: STF-6645

Equipment#	Reading Loc.	Distance Loc.	Reading	Notes
1303	12:00	34'	0.334"	
1303	3:00	34'	0.336"	
1303	6:00	34'	0.334"	
1303	9:00	34'	0.335"	
1303	12:00	36'	N/A	Manway
1303	3:00	36'	0.333"	
1303	6:00	36'	0.334"	
1303	9:00	36'	0.334"	
1303	12:00	1"	0.335"	
1303	3:00	1"	0.334"	
1303	6:00	1"	0.333"	
1303	9:00	1"	0.332"	
1303	Center	Back Head	0.371"	
1303	12:00	Back Head	0.365"	
1303	3:00	Back Head	0.385"	
1303	6:00	Back Head	0.384"	
1303	9:00	Back Head	0.393"	

Notes: Internal thickness readings were taken beginning at the front of the tank, proceeding back towards the manway. 5 readings were taken on each end cap, 4 readings (12:00, 3:00, 6:00, and 9:00) were taken 1" from the end cap weld seam, and then 4 thickness readings were taken every 2' beginning from the front end cap weld seam and ending 1" from the back end cap weld seam. 5 thickness readings were also taken on the back end cap.

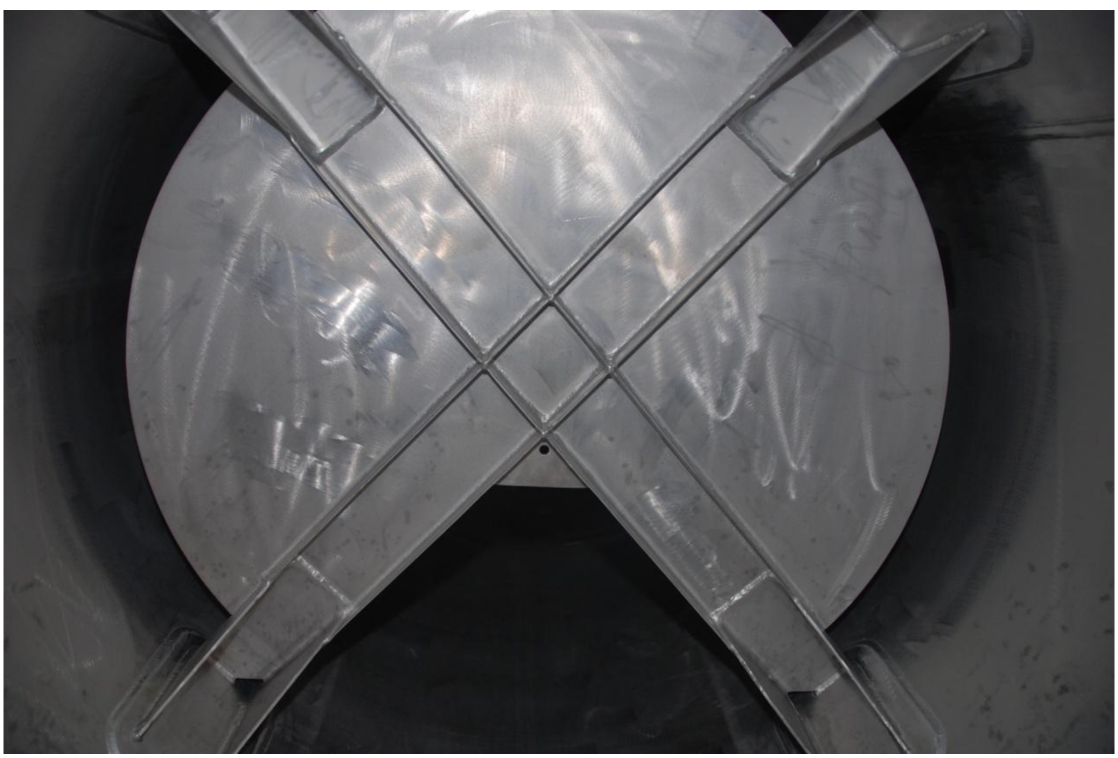
Name: Jacob Hatchett   Level: II   Signature: *Jacob Hatchett*

APPENDIX D. ESI METALLOGRAPHIC AND SEM DOCUMENTATION

(Due to the extremely large file size, this appendix is provided on CD-ROM)

APPENDIX E. PHOTOGRAPHS FROM SECOND VISUAL ASSESSMENT BY BAKERRISK

Photograph 45 Trailer 807 Serial No. C-09790

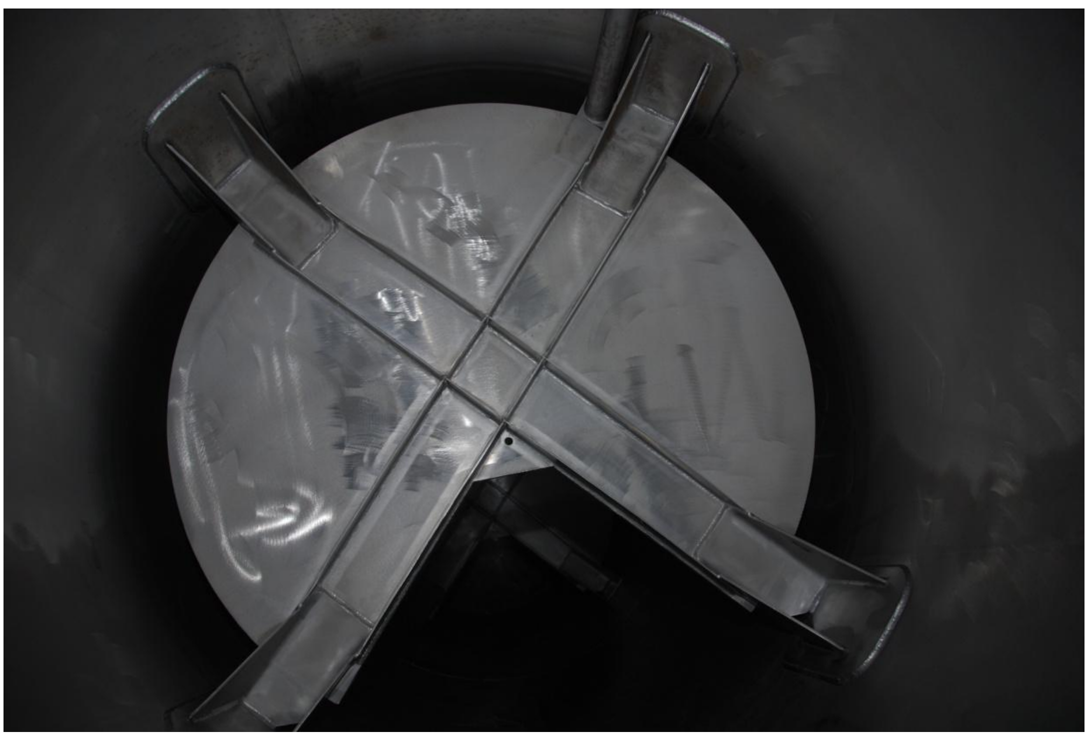


Photograph 46 Trailer 807 Serial No. C-09790

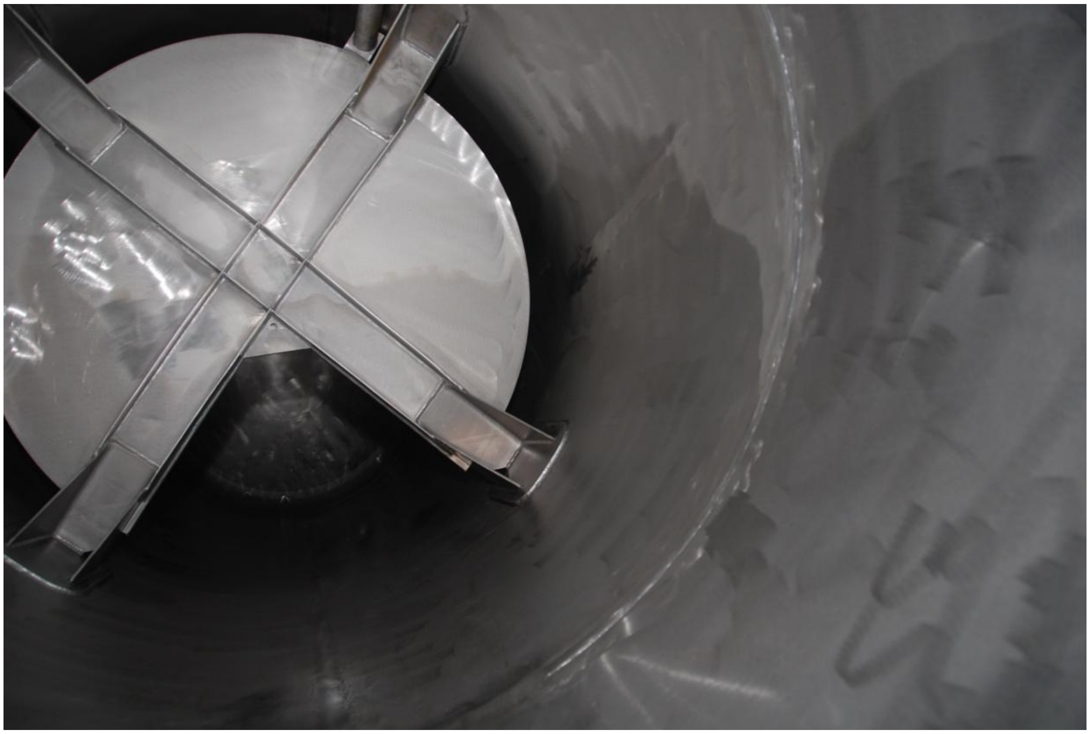
Photograph 47 Trailer 807 Serial No. C-09790

Photograph 48 Trailer 807 Serial No. C-09790

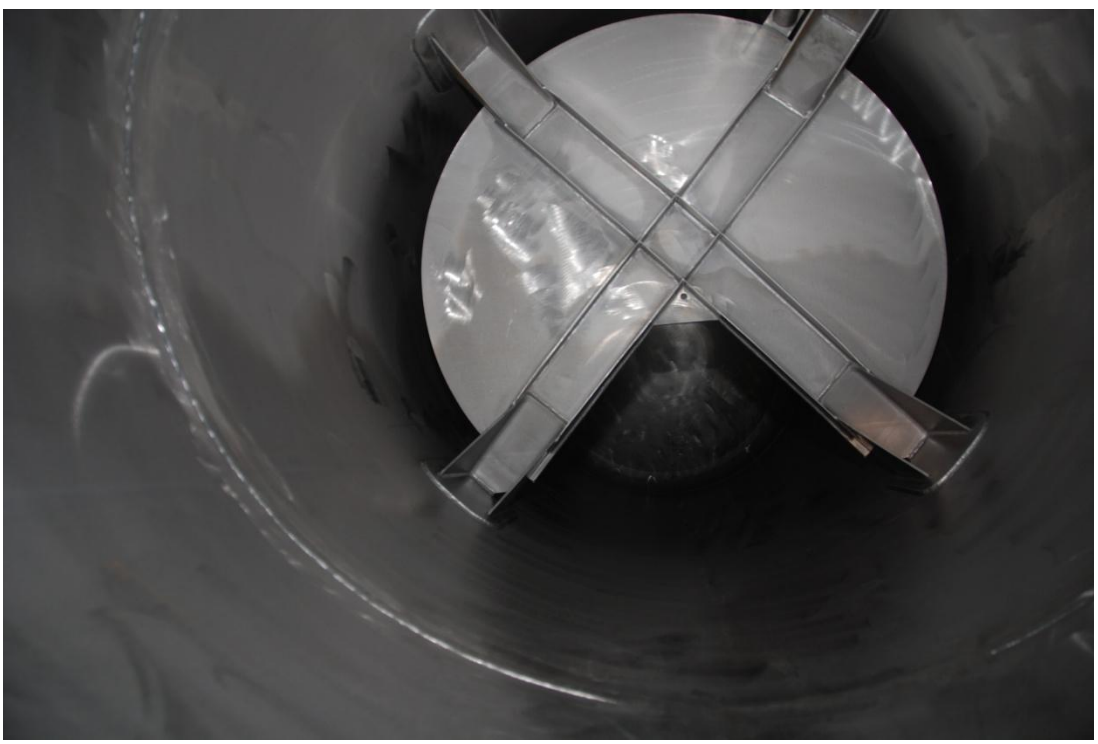
Photograph 49 Trailer 805 Serial No. C-09590



Photograph 50 Trailer 805 Serial No. C-09590

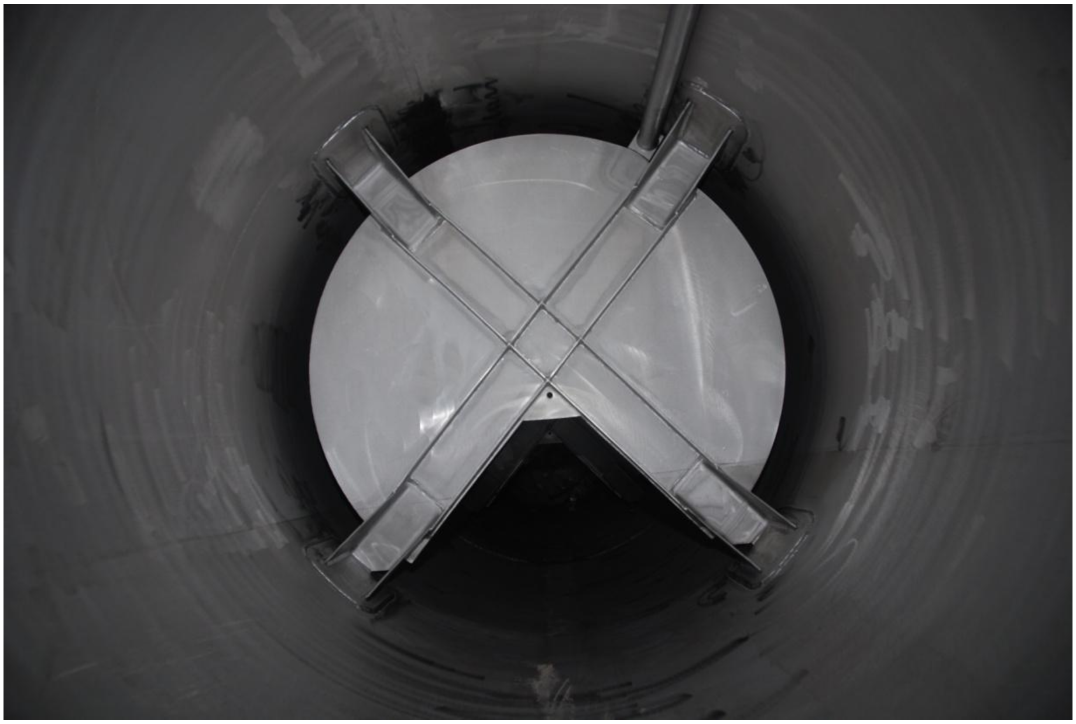


Photograph 51 Trailer 805 Serial No. C-09590

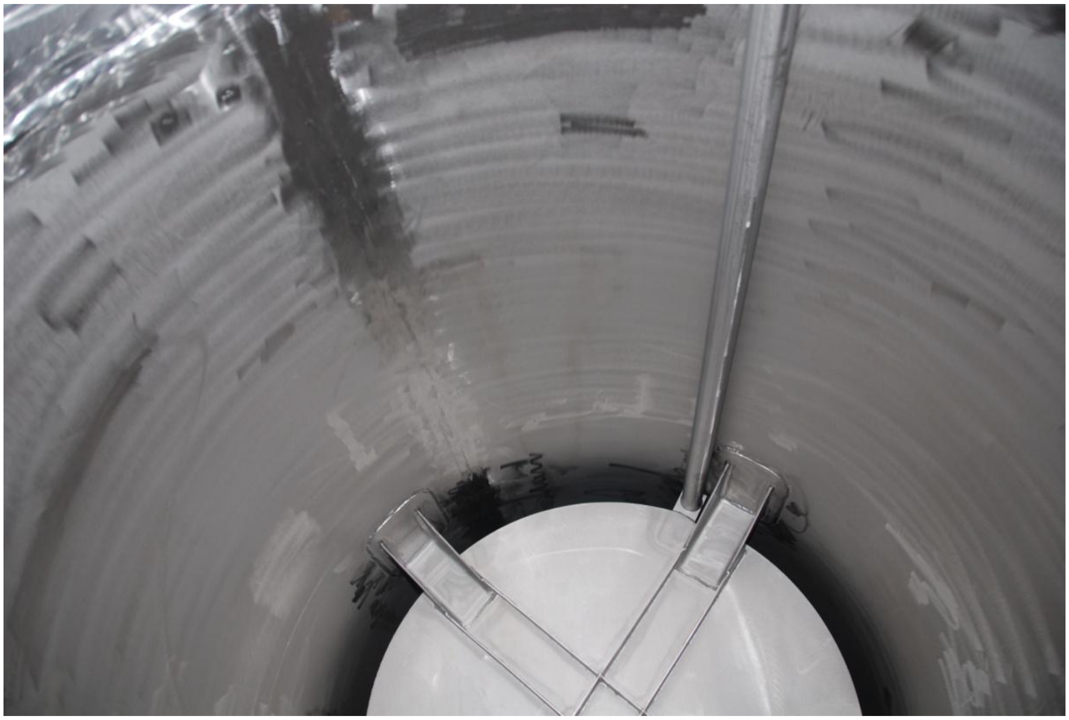


Photograph 52 Trailer 805 Serial No. C-09590

Photograph 53 Trailer 805 Serial No. C-09590



Photograph 54 Trailer 805 Serial No. C-09590

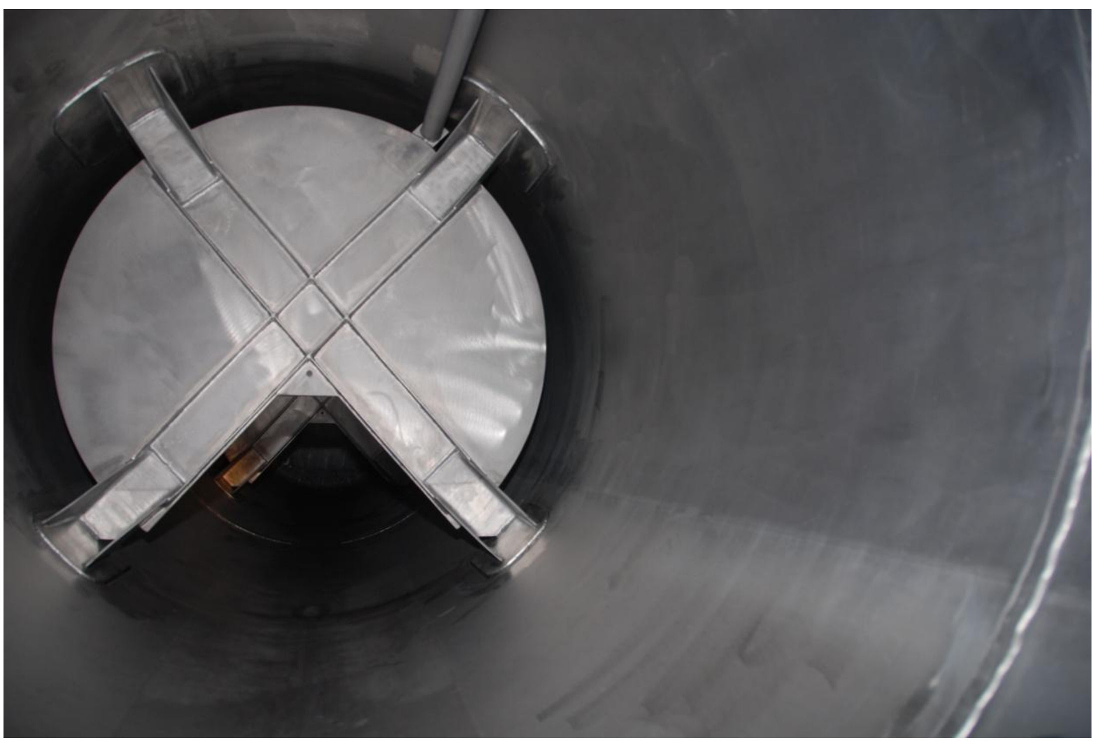


\\\\

Photograph 55 Trailer 805 Serial No. C-09590

Photograph 56 Trailer 805 Serial No. C-09590

Photograph 57 Trailer 803 Serial No. C-10090



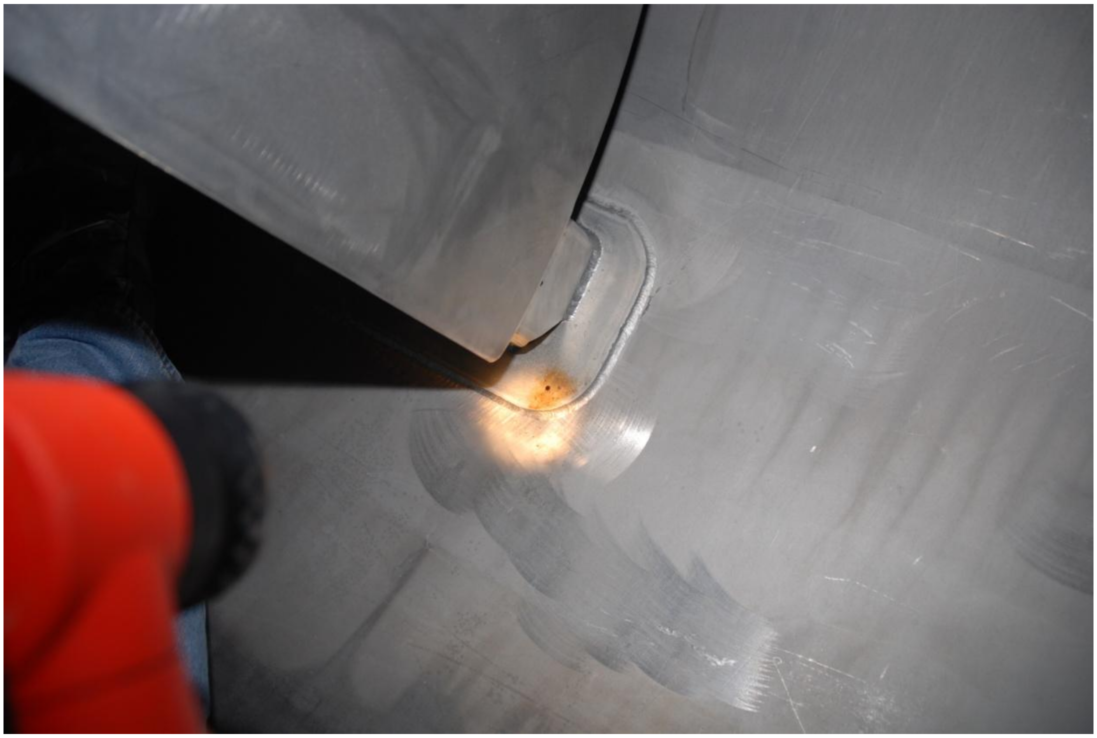
Photograph 58 Trailer 803 Serial No. C-10090

Photograph 58 Trailer 803 Serial No. C-10090

Photograph 59 Trailer 803 Serial No. C-10090

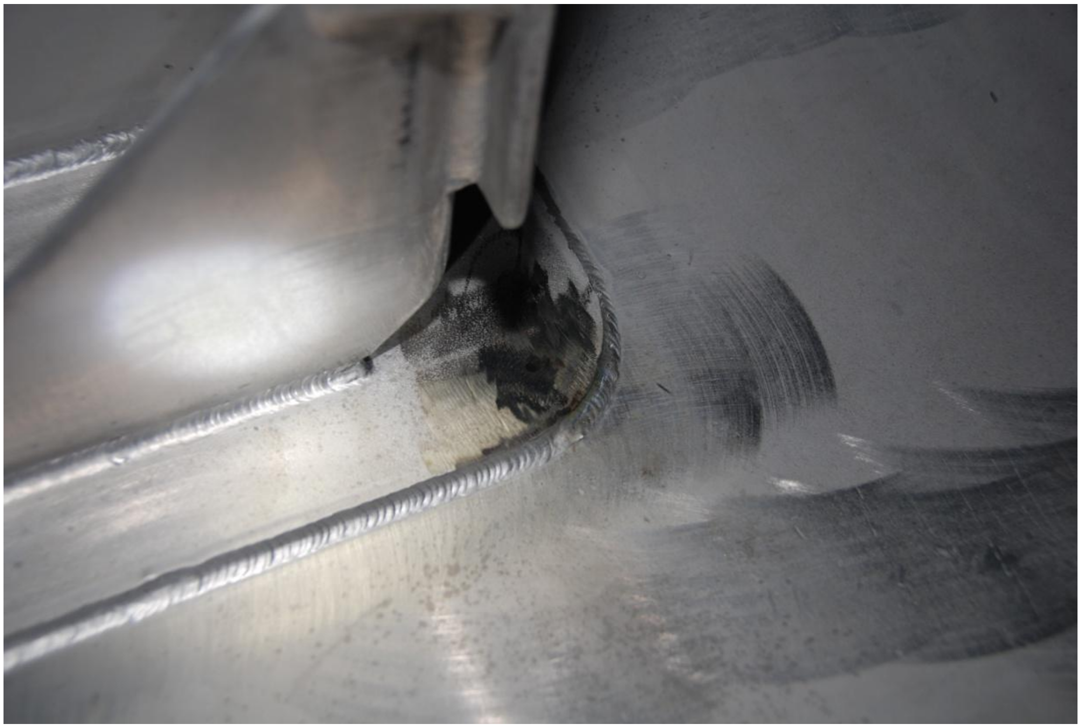
Photograph 60 Trailer 803 Serial No. C-10090

Photograph 62 Trailer 803 Serial No. C-10090



Photograph 63 Trailer 803 Serial No. C-10090

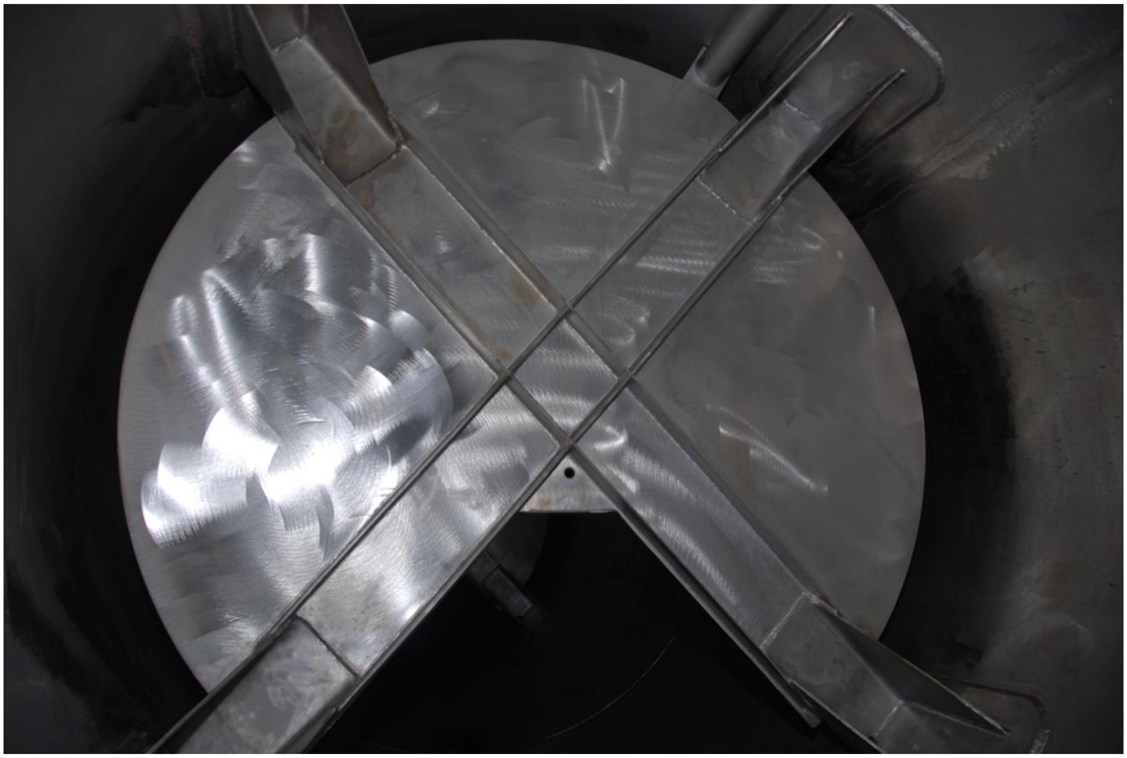
Photograph 64 Trailer 803 Serial No. C-10090



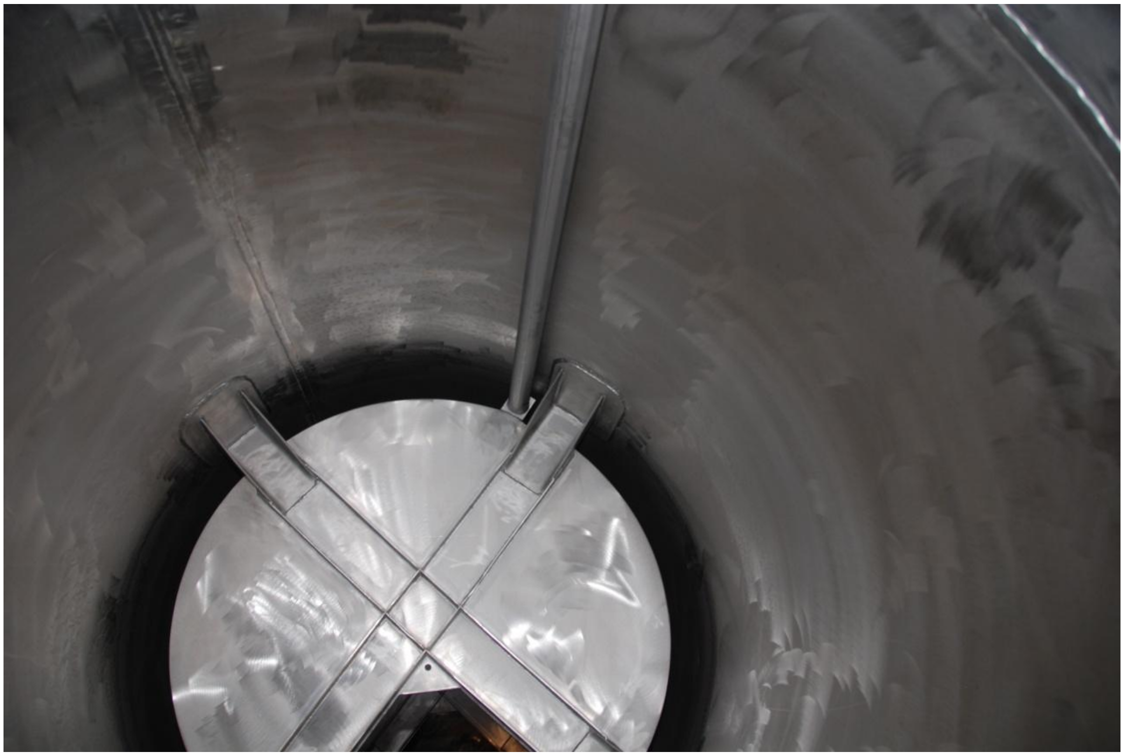
Photograph 65 Trailer 803 Serial No. C-10090

Photograph 66 Trailer 803 Serial No. C-10090

Photograph 67 Trailer 843 Serial No. C-09490



Photograph 68 Trailer 843 Serial No. C-09490

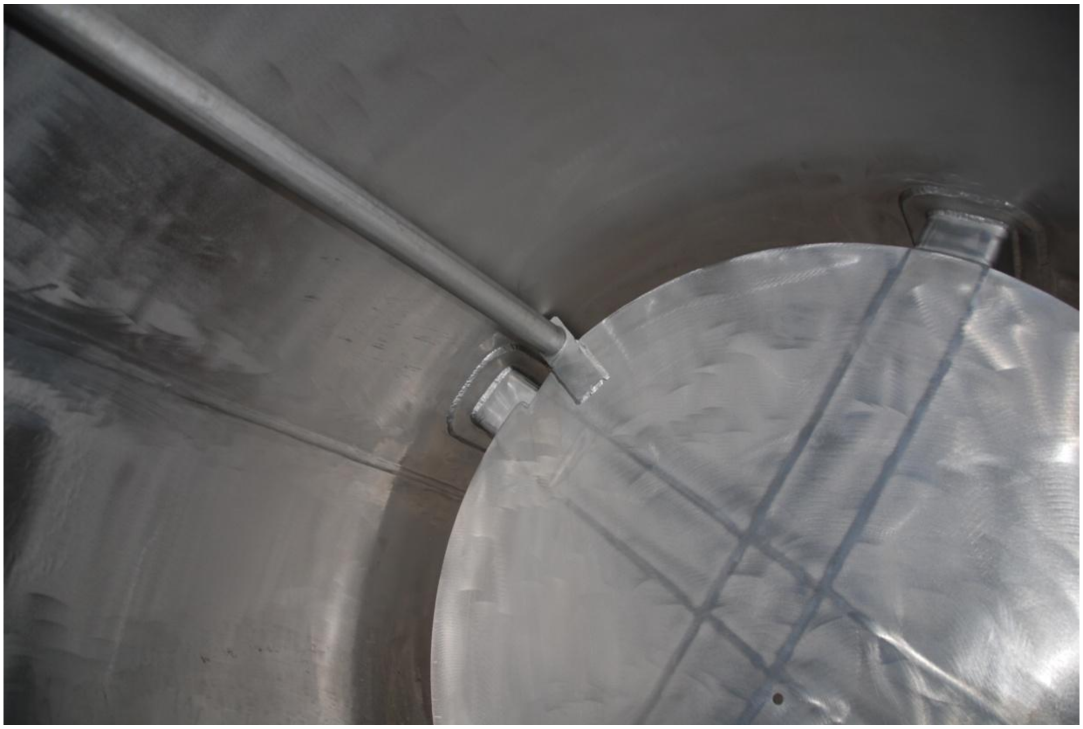


Photograph 69 Trailer 843 Serial No. C-09490

Photograph 70 Trailer 843 Serial No. C-09490

Photograph 71 Trailer 809 Serial No. C-09990

Photograph 72 Trailer 809 Serial No. C-09990



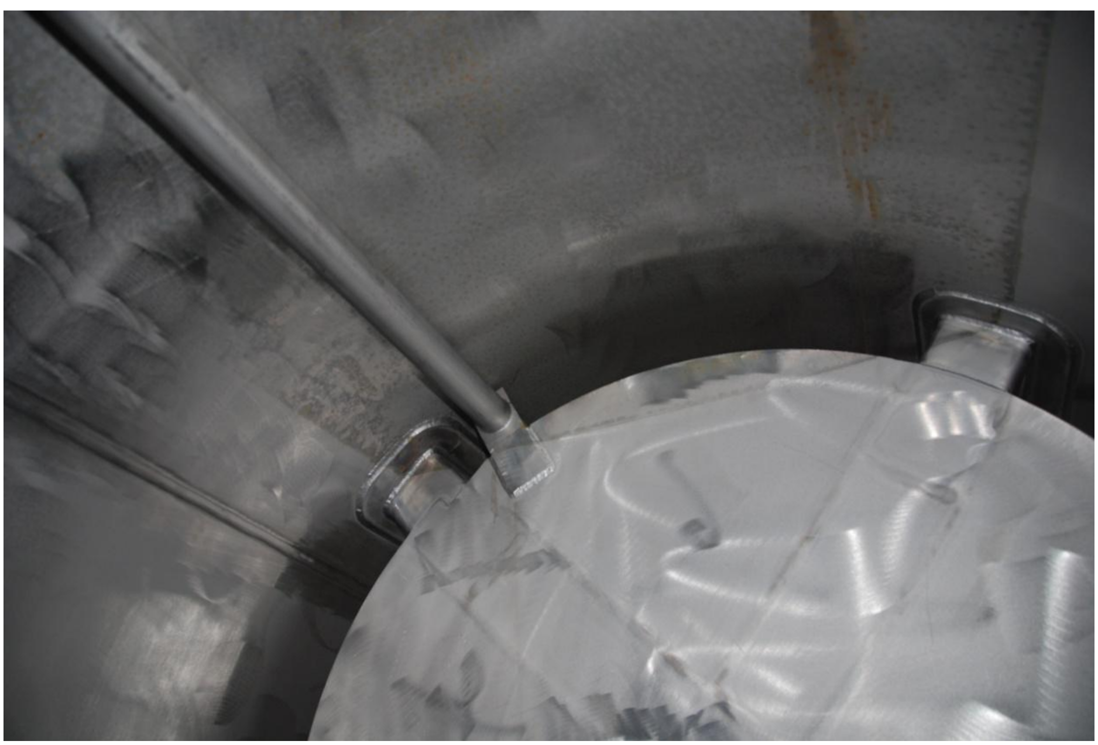
Photograph 73 Trailer 809 Serial No. C-09990

Photograph 74 Trailer 809 Serial No. C-09990

Photograph 75 Trailer 808 Serial No. C-09890

Photograph 76 Trailer 808 Serial No. C-09890

Photograph 77 Trailer 808 Serial No. C-09890



Photograph 78 Trailer 808 Serial No. C-09890

Photograph 79 Trailer 1190 Serial No. STE-6065

Photograph 80 Trailer 1190 Serial No. STE-6065

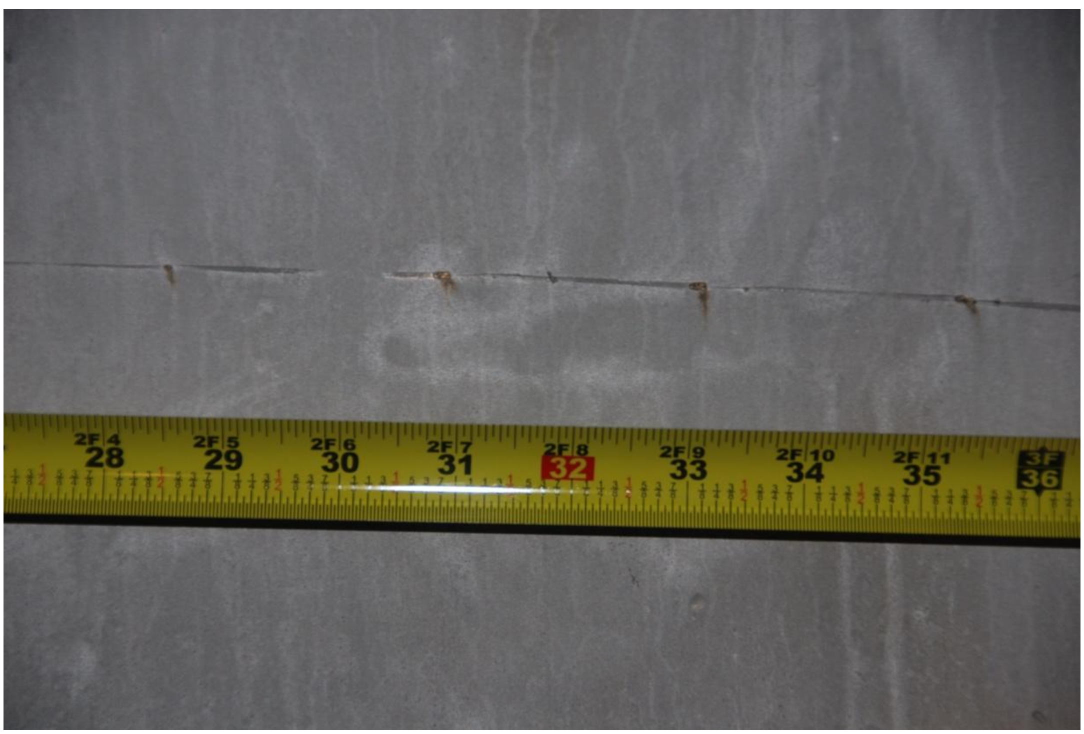
Photograph 81 Trailer 1190 Serial No. STE-6065

Photograph 82 Trailer 1190 Serial No. STE-6065

Photograph 83 Trailer 1303 Serial No. STE-6645

Photograph 84 Trailer 1303 Serial No. STE-6645

Photograph 85 Trailer 1303 Serial No. STE-6645



Photograph 86 Trailer 1303 Serial No. STE-6645

APPENDIX F. EXAMINATION RESULTS: EVANS ANALYTICAL GROUP AND E. I. DUPONT LABORATORIES

AUGER ELECTRON SPECTROSCOPY (AES)
SURFACE ANALYSIS REPORT
17 Sep 2009

JOB NUMBER P09ZB627
PO NUMBER Z1338

for

Kent Johnson
Baker Engineering and Risk Consultants
8430 Bryn Mawr Avenue
Suite 720
Chicago, IL 60631

Prepared by:

Patrick McKeown
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AUGER ELECTRON SPECTROSCOPY (AES) ANALYSIS REPORT

Purpose: Three samples were submitted for Auger Electron Spectroscopy (AES) analysis. The samples were identified as A, B, and C and described as 314L sections of a tank. The three samples had been treated, cross-sectioned, and polished. The goal for the analysis was to look for chlorine, fluorine, or oxides in small surface stress corrosion cracks on each of the three samples.

Summary: Neither chlorine nor fluorine was detected in any of the cracks. Most of the cracks did contain carbon and a few also contained aluminum and oxygen (possibly Al_2O_3 polishing materials embedded during sample preparation).

Experimental: The samples were mounted on a stainless steel puck and placed in the system load-lock. Clean tweezers and gloves were used for all sample handling. No additional cleaning steps were implemented. After sufficient evacuation, the sample puck was inserted into the analytical chamber and placed in front of the analyzer. Secondary electron imaging was used to locate and record areas of analysis. The quantification of the elements was accomplished by using the elemental sensitivity factors.

Analytical conditions:

Instrument	Physical Electronics 680 Scanning Auger Nanoprobe
Electron Beam conditions	10keV, 13nA, 30° from sample normal
Ion Beam conditions	3 keV Ar^+, 2.0µA, $(4mm)^2$ raster
Sputter rate	64Å/minute SiO_2

Experimental: The uncertainty in the energy assignment to Auger signals is less than 2eV (following the calibration procedure described under ISO 17973). In the absence of spectral overlaps this generally allows for an unambiguous identification of an element present on the surface of a sample at levels above the detection limit. If spectral overlaps exist Auger spectra must be screened for the potential presence of secondary signals. Since a large number of elements have multiple Auger signal it is most often possible to confirm the presence of an element even in cases of spectral overlaps of some of the signals.

The atomic concentrations provided can typically be reproduced for major constituents of thin film or surface layer to within ±10%(providing a level of confidence of approximately 95% using a coverage factor of k ~ 2). For elements present at levels below 10at% down to the detection limit (at ~0.5at%) the uncertainty in the reproducibility of the results can be significantly larger. Auger should be considered a “semi-quantitative” analysis technique meaning the atomic concentrations provided in this report can be reproduced well within EAG. However, the atomic concentrations provided could have a “bias” when compared to certified references materials (e.g. NIST standard reference materials). This “bias” can be corrected for by calibration of the sensitivity factors against such certified reference materials. Since only a limited number of certified reference materials exist the majority of Auger users default to using sensitivity factors provided by their instrument manufacturer (in case of EAG Physical Electronics).

Results: Prior to AES data acquisition, secondary electron images (SEI's) were obtained from each sample. The SEIs were used to locate and document the analysis area locations and to document the surface morphology. The SEIs were acquired at magnifications of 150X and 1,000X.

Survey spectra were generally obtained from two spots near each corrosion crack analyzed. One survey was obtained from the polished steel surface and the second from the crack. Iron, chromium, and nickel were detected in all of the control area spectra. Carbon, oxygen, iron, and chromium were detected in the spectra obtained from the cracks on sample A. Neither chlorine nor fluorine was detected in any of the cracks. For samples B and C the samples were also sputter cleaned in an attempt to reduce that carbon in the cracks and look for any evidence of chlorine and fluorine. None was found. Many of the corrosion crack areas were mapped to look for any locations that contained less carbon and possibly areas that contained oxides or chlorine. Again, none were found.

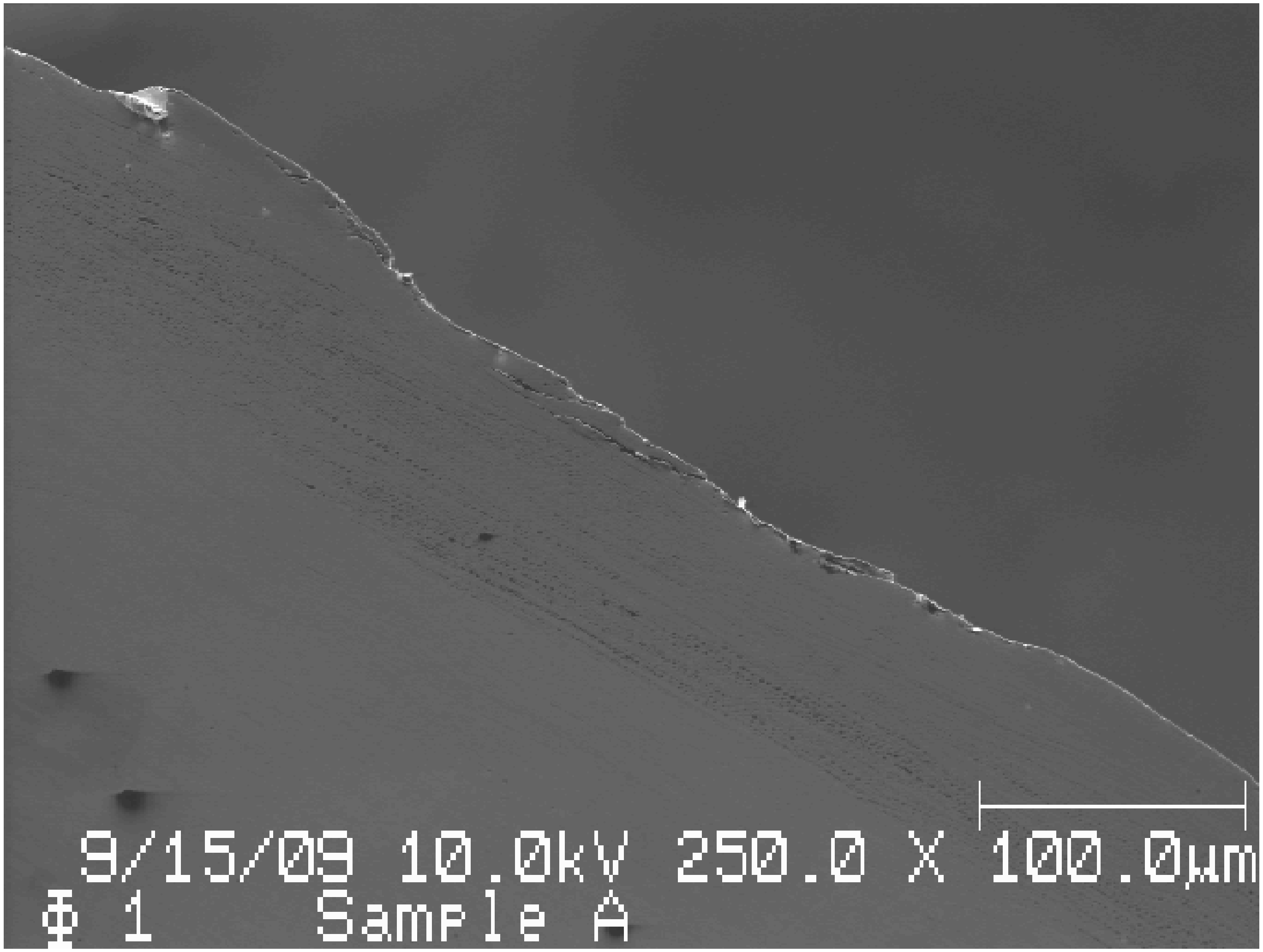
Table I
Concentration of Elements Detected on the As-Received Surface (in Atom%†)

FileName	Sample ID	C	O	Al	Cr	Fe	Ni
P09ZB627104.spe	A, area 1a	51	nd	nd	9	36	4
P09ZB627104.spe	A, area 1b	52	nd	nd	8	35	4
P09ZB627106.spe	A, area 2a	32	13	nd	11	39	5
P09ZB627202.spe	B, area 1a	82	12	nd	nd	5	1
P09ZB627202.spe	B, area 1b	90	7	nd	nd	2	1
P09ZB627203.spe	B, area 2a	6	nd	nd	19	68	8
P09ZB627203.spe	B, area 2b	30	36	17	6	9	1
P09ZB627205.spe	B, area 3a	nd	nd	nd	20	72	8
P09ZB627205.spe	B, area 3b	98	2	nd	nd	nd	nd
P09ZB627208.spe	B, area 4a	nd	nd	nd	20	73	7
P09ZB627208.spe	B, area 4b	100	nd	nd	nd	nd	nd
P09ZB627211.spe	B, area 5a	nd	nd	nd	21	72	7
P09ZB627211.spe	B, area 5b	86	4	nd	2	9	nd
P09ZB627214.spe	B, area 6a	19	nd	nd	16	59	6
P09ZB627214.spe	B, area 6b	97	3	nd	nd	nd	nd
P09ZB627220.spe	B, area 7a	24	50	nd	19	8	nd
P09ZB627301.spe	C, area 1a	nd	nd	nd	21	72	7
P09ZB627301.spe	C, area 1b	100	nd	nd	nd	nd	nd
P09ZB627304.spe	C, area 2a	nd	nd	nd	20	73	8
P09ZB627304.spe	C, area 2b	70	17	nd	4	10	nd

† Table 1 provides the atomic concentrations of the elements detected. Auger does not detect H or He. The concentrations were calculated by first measuring elemental peak-to-peak heights within the spectral window chosen for a given element and then applying sensitivity factors based on standard spectra of pure elements or selected compounds. The choice of sensitivity factors greatly affects the accuracy of the absolute concentrations provided. The chosen sensitivity factors are standard sensitivity factors supplied by Physical Electronics and not adjusted (calibrated) to the materials analyzed in this analysis. Therefore the accuracy of the provided absolute concentrations might be low; however relative comparisons between similar sets of samples can be made. The concentrations are expressed as percentages (atomic) for the elements detected within the analysis volume and normalized to 100%.

After reviewing this report, you may assess our services using an electronic service evaluation form. This can be done by clicking on the link below, or by pasting it into your internet browser. Your comments and suggestions allow us to determine how to better serve you in the future. http://www.eaglabs.com/evaluate.htm?job=P09ZB627

Secondary Electron Image: Sample A



Figure

Secondary Electron Image: Sample A

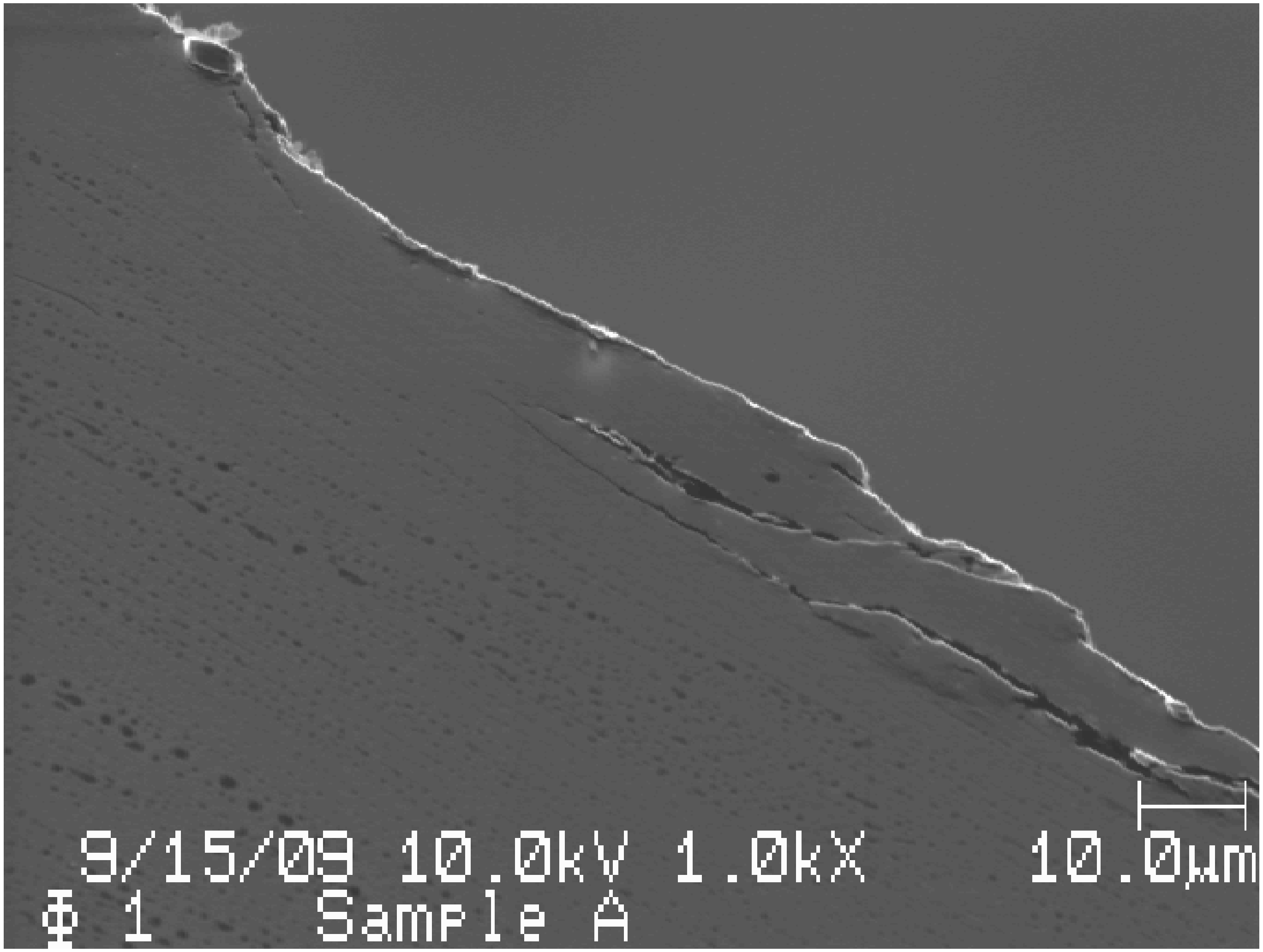
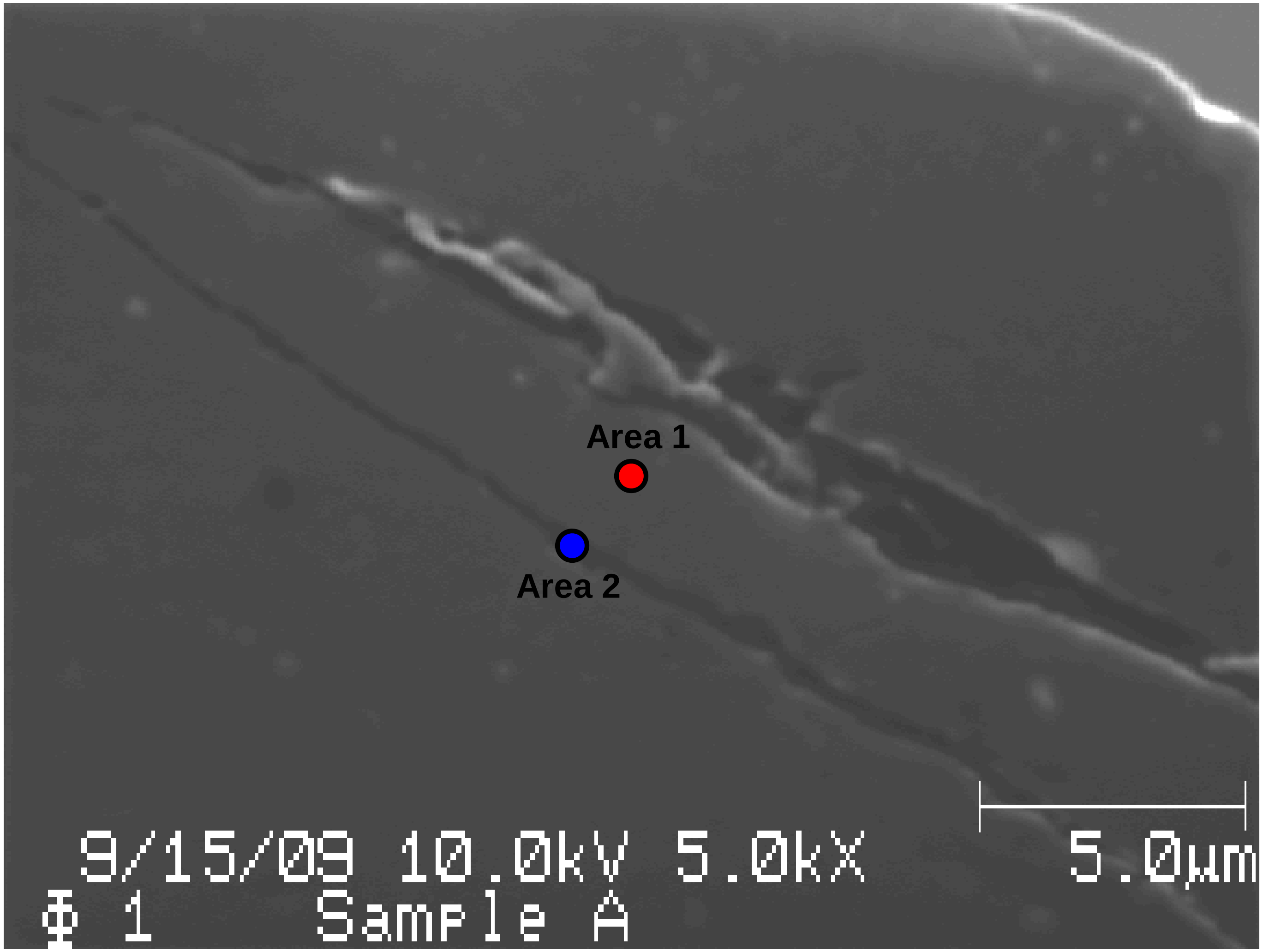


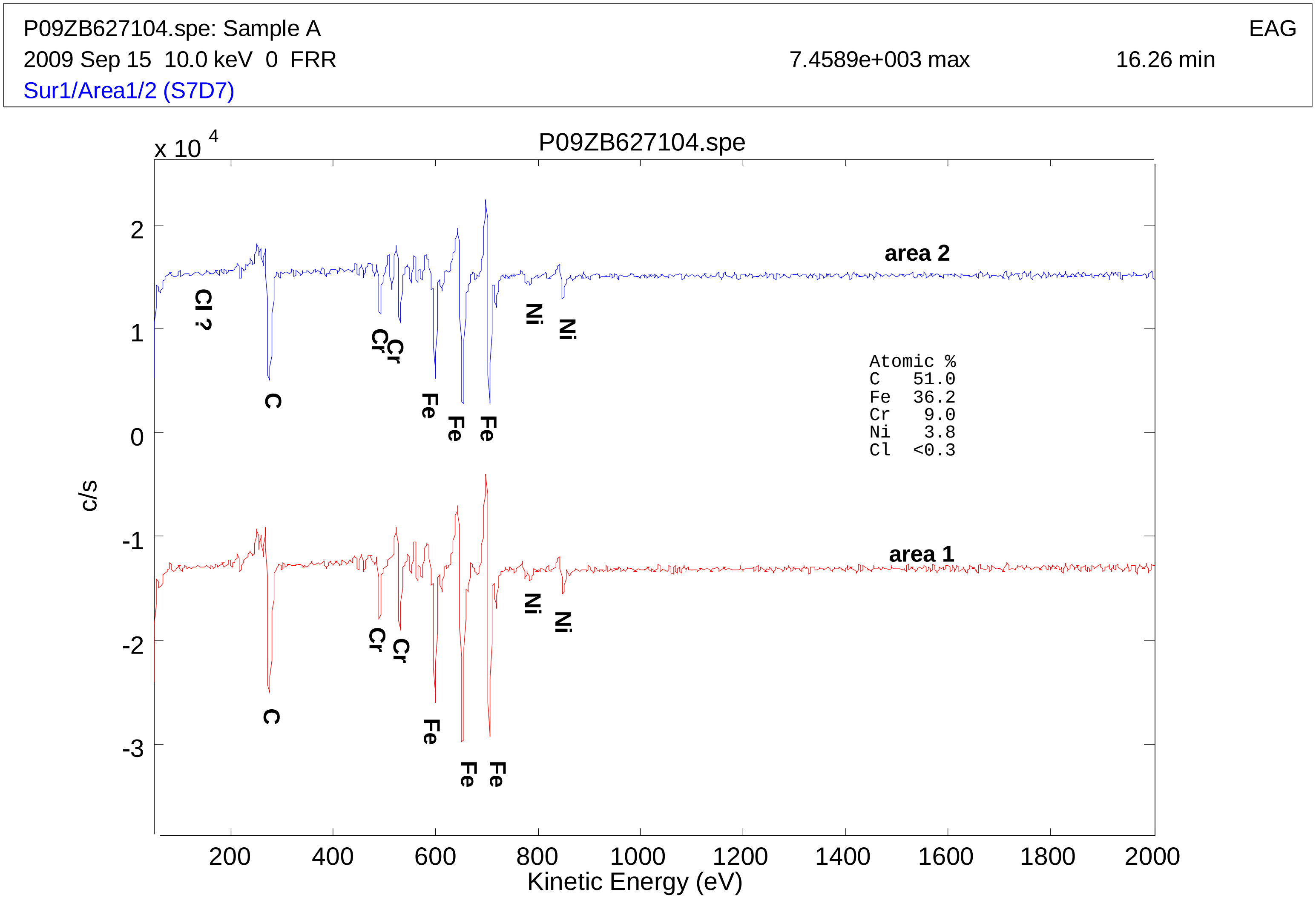
Figure 2

Secondary Electron Image: Sample A



Figure

AES Survey Spectra: Sample A



Figure

Secondary Electron Image: Sample A

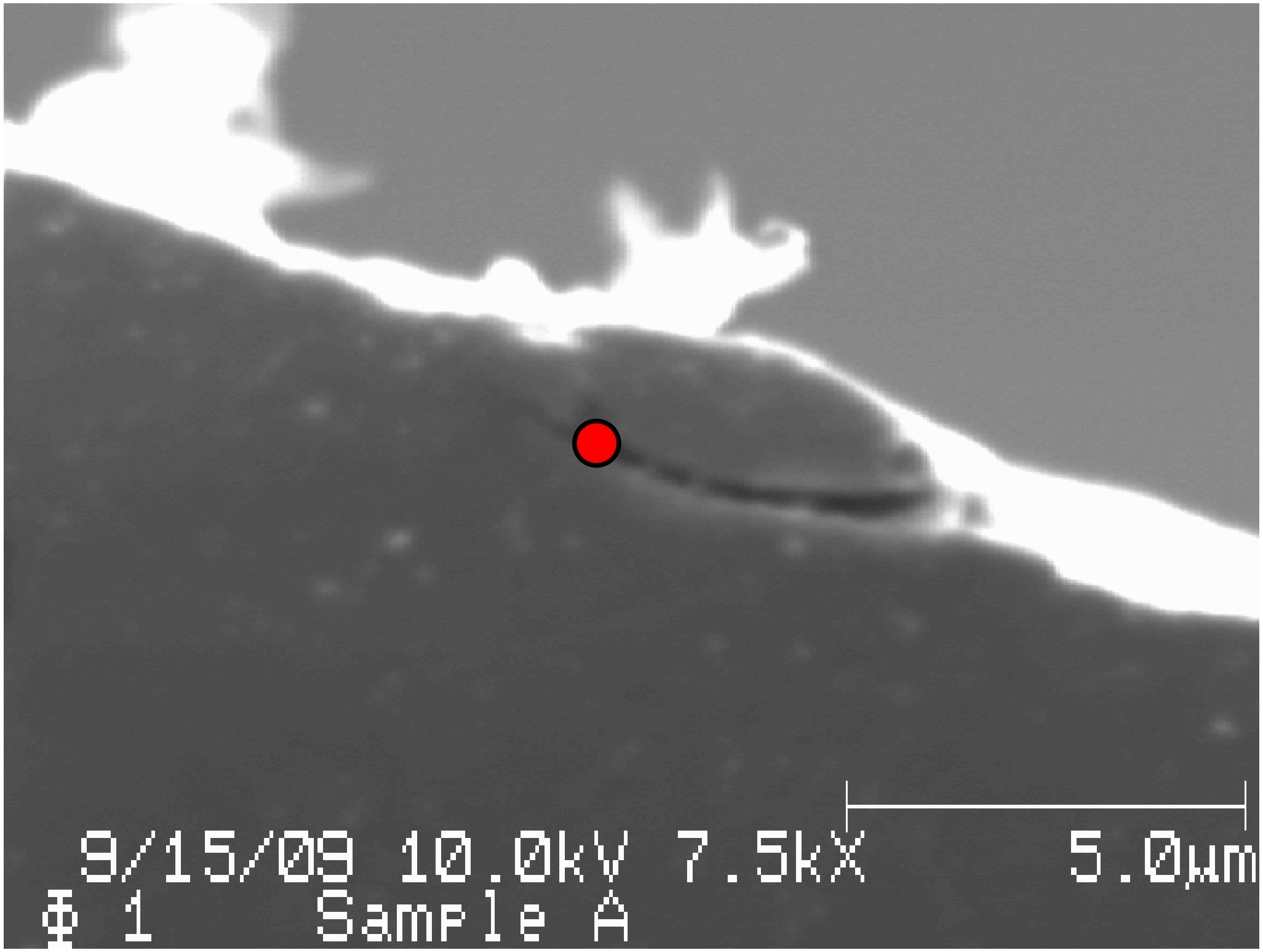
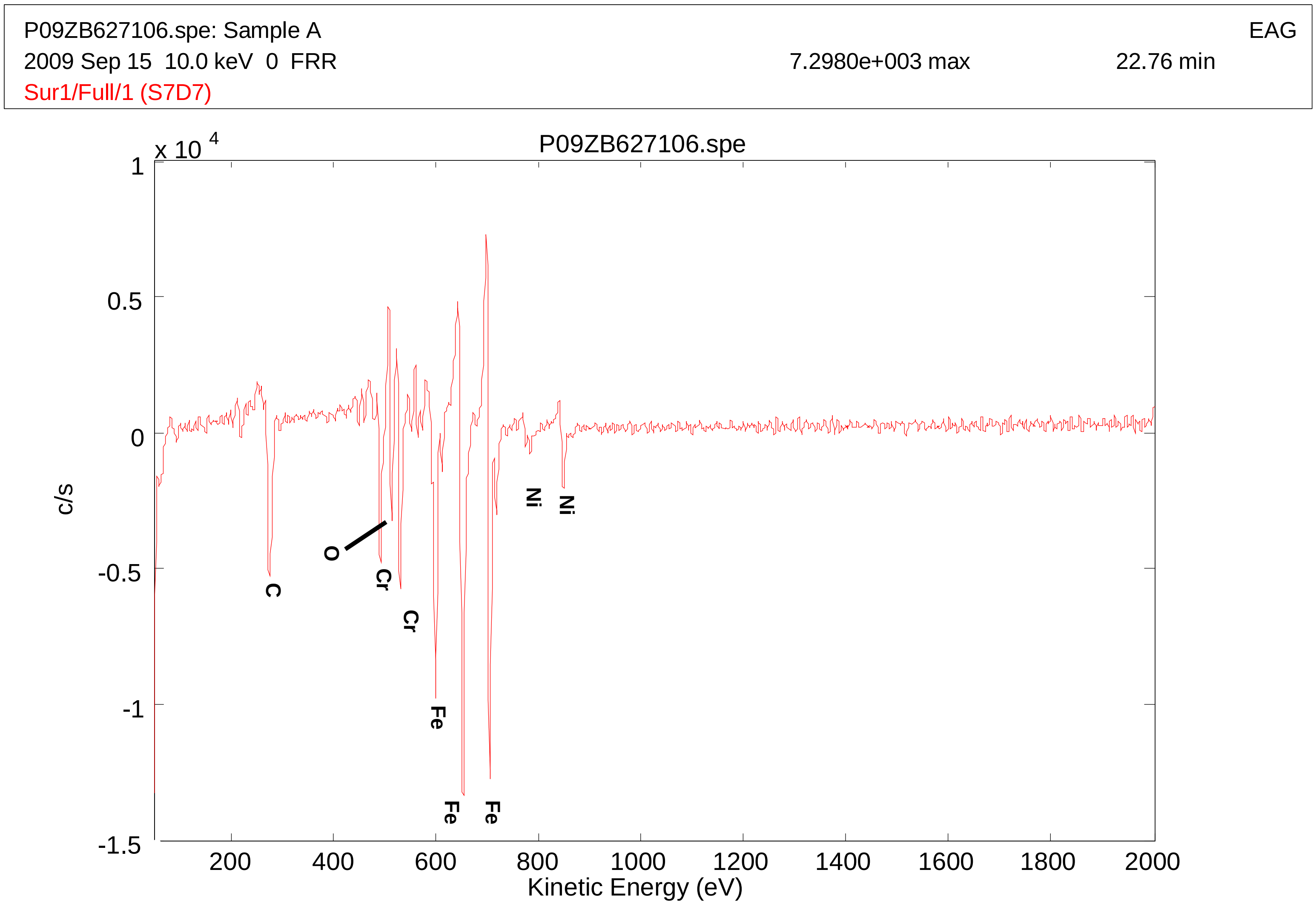


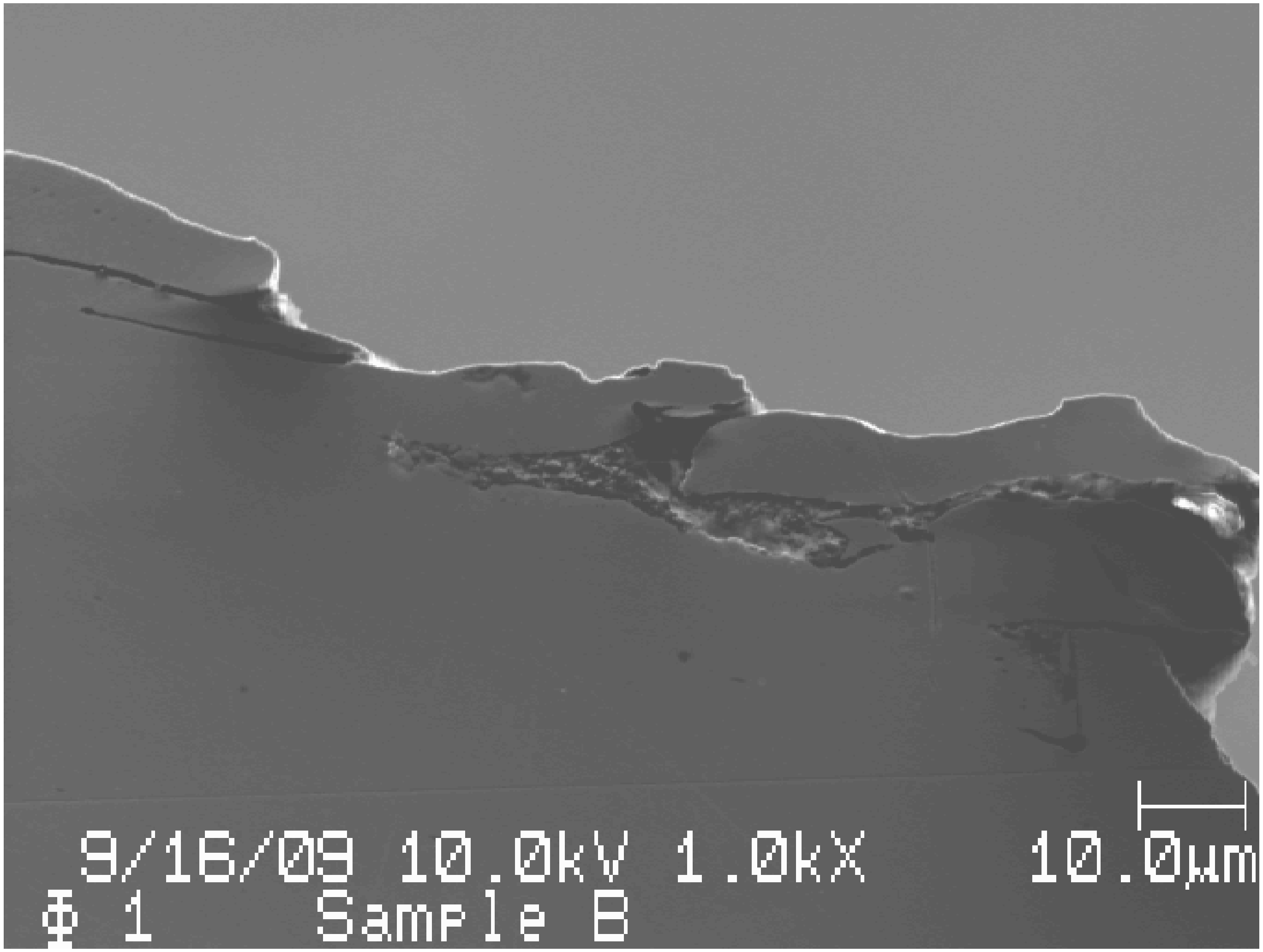
Figure 5

AES Survey Spectrum: Sample A



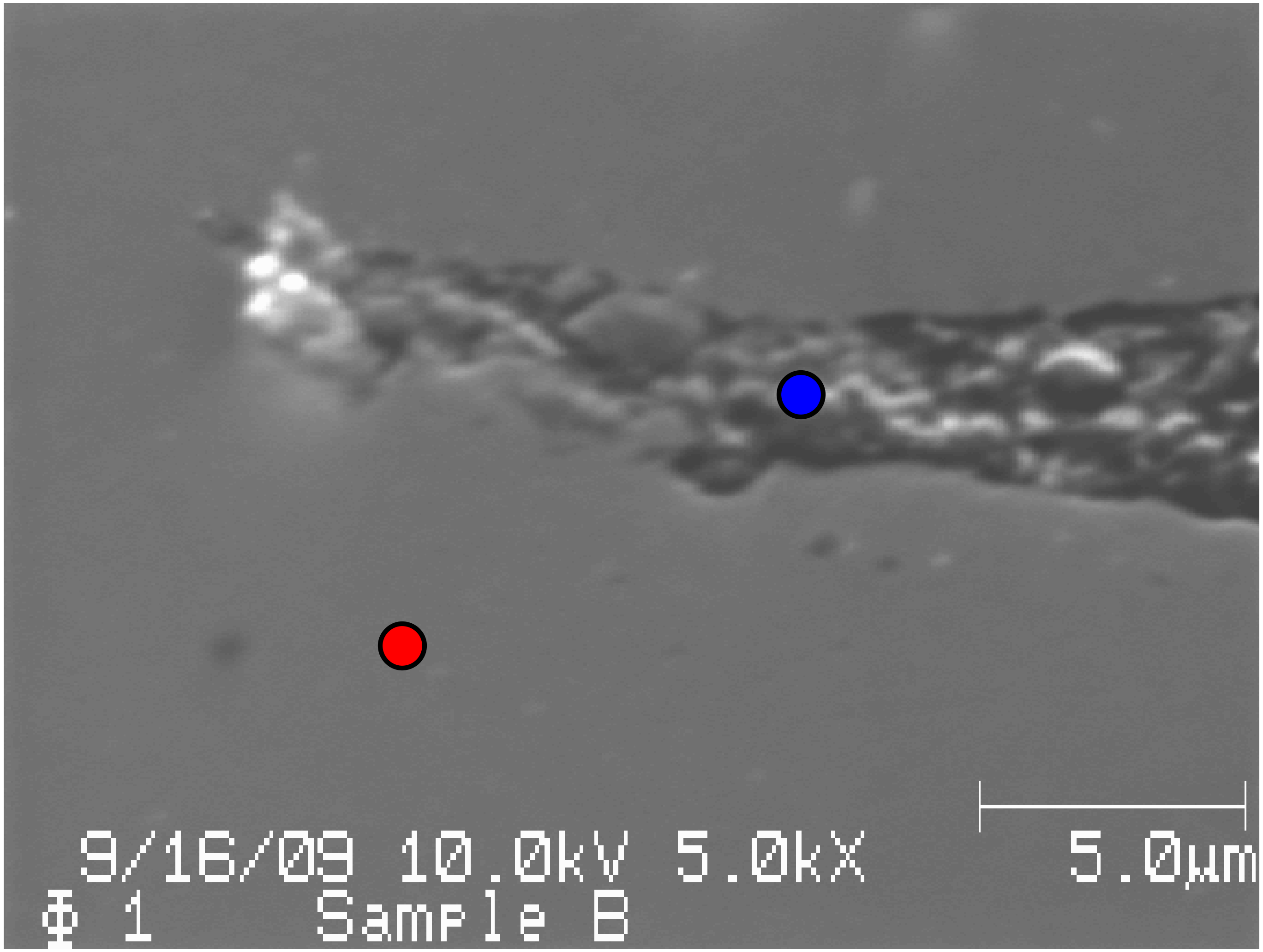
Figure

Secondary Electron Image: Sample B



Figure

Secondary Electron Image: Sample B



Figure

AES Surface Survey Spectra: Sample B

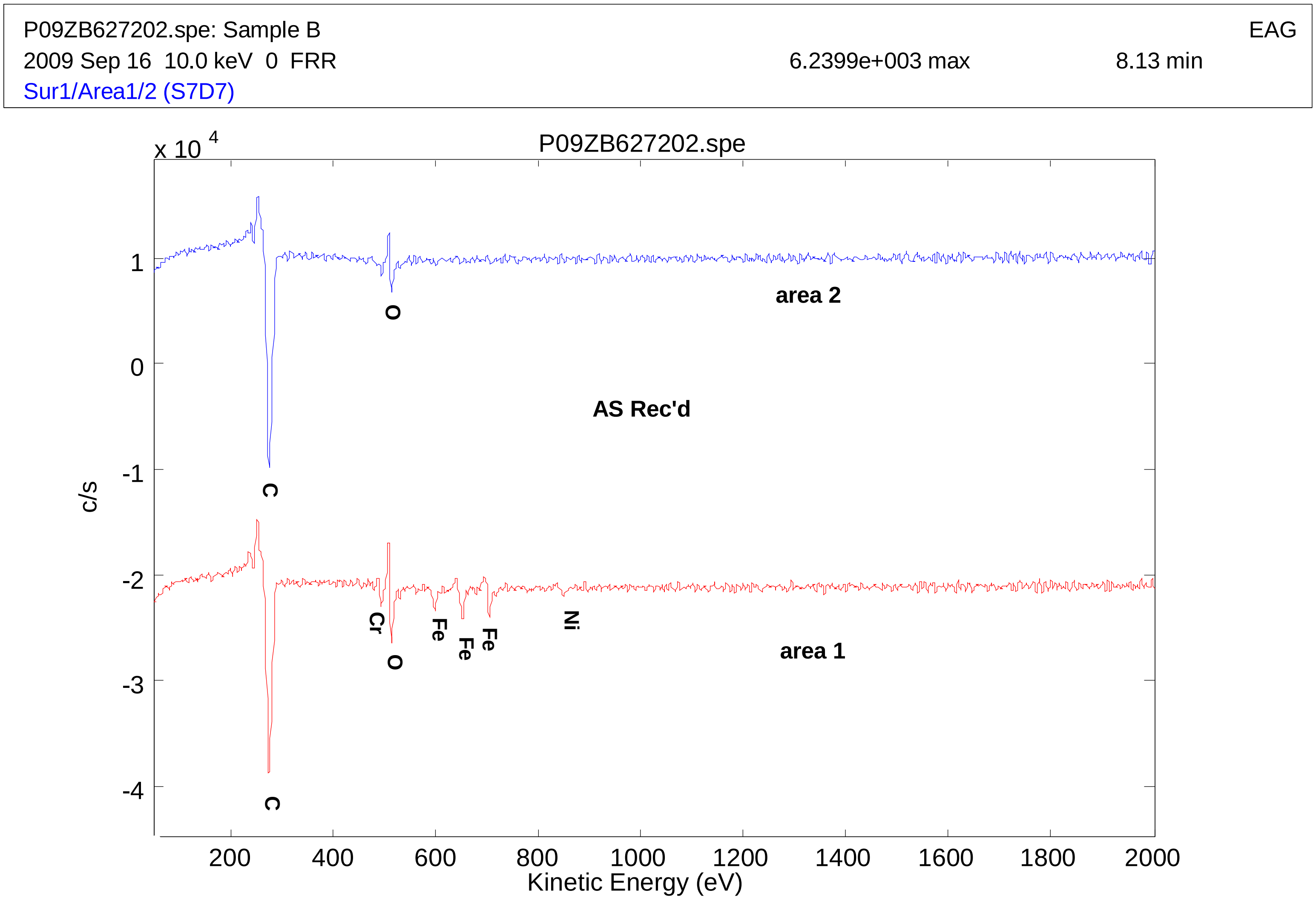
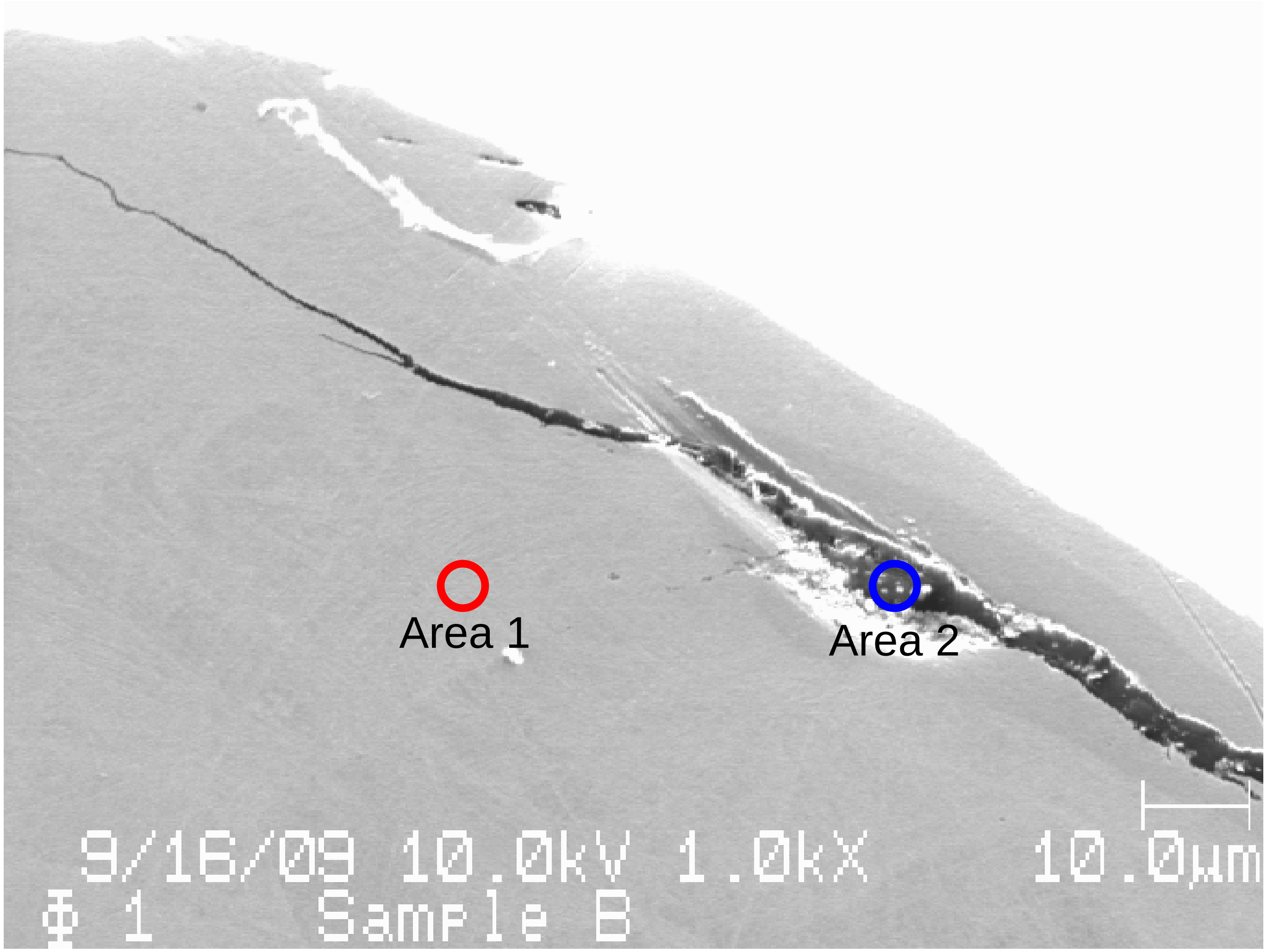


Figure 9

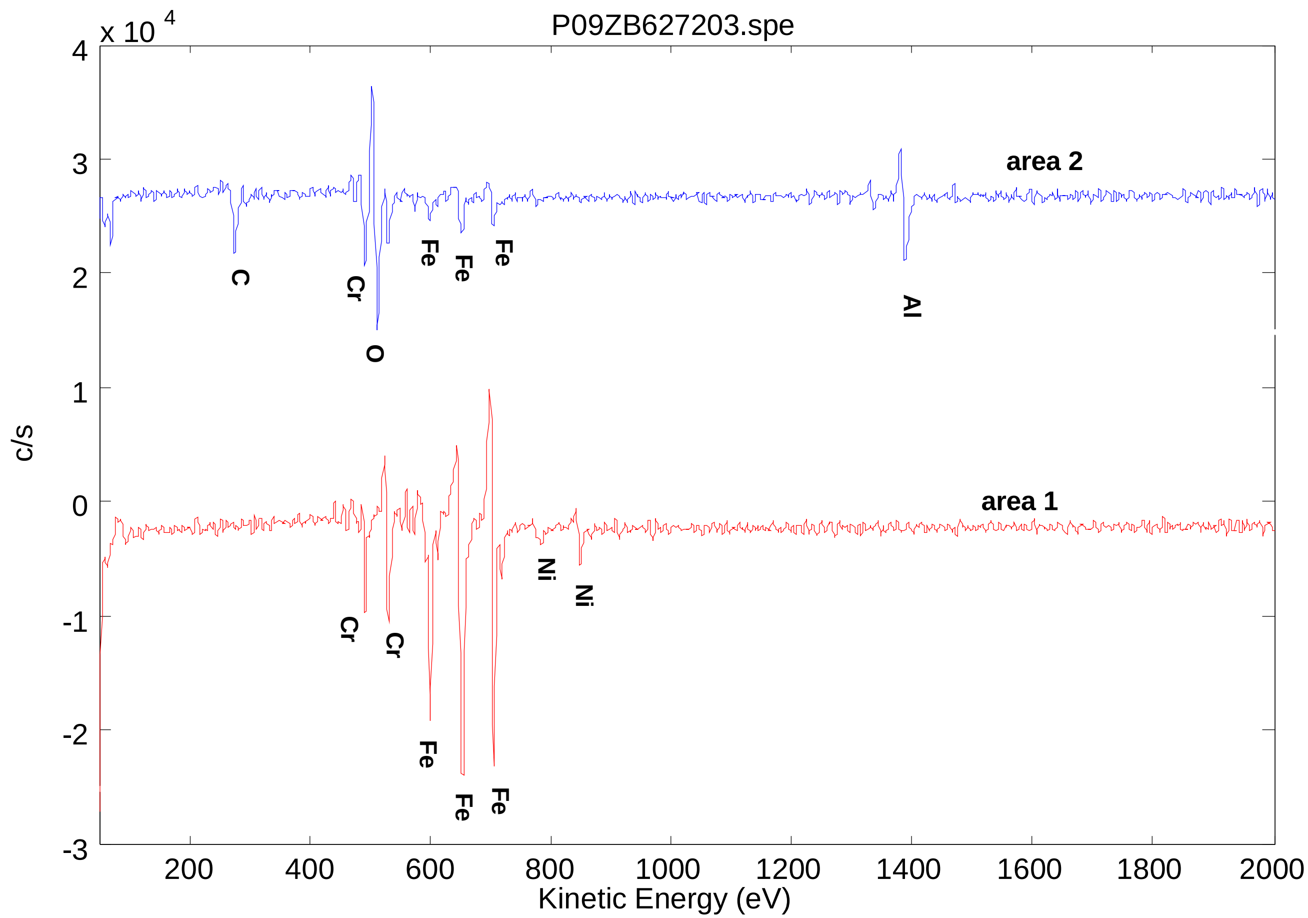
Secondary Electron Image: Sample B



Figure

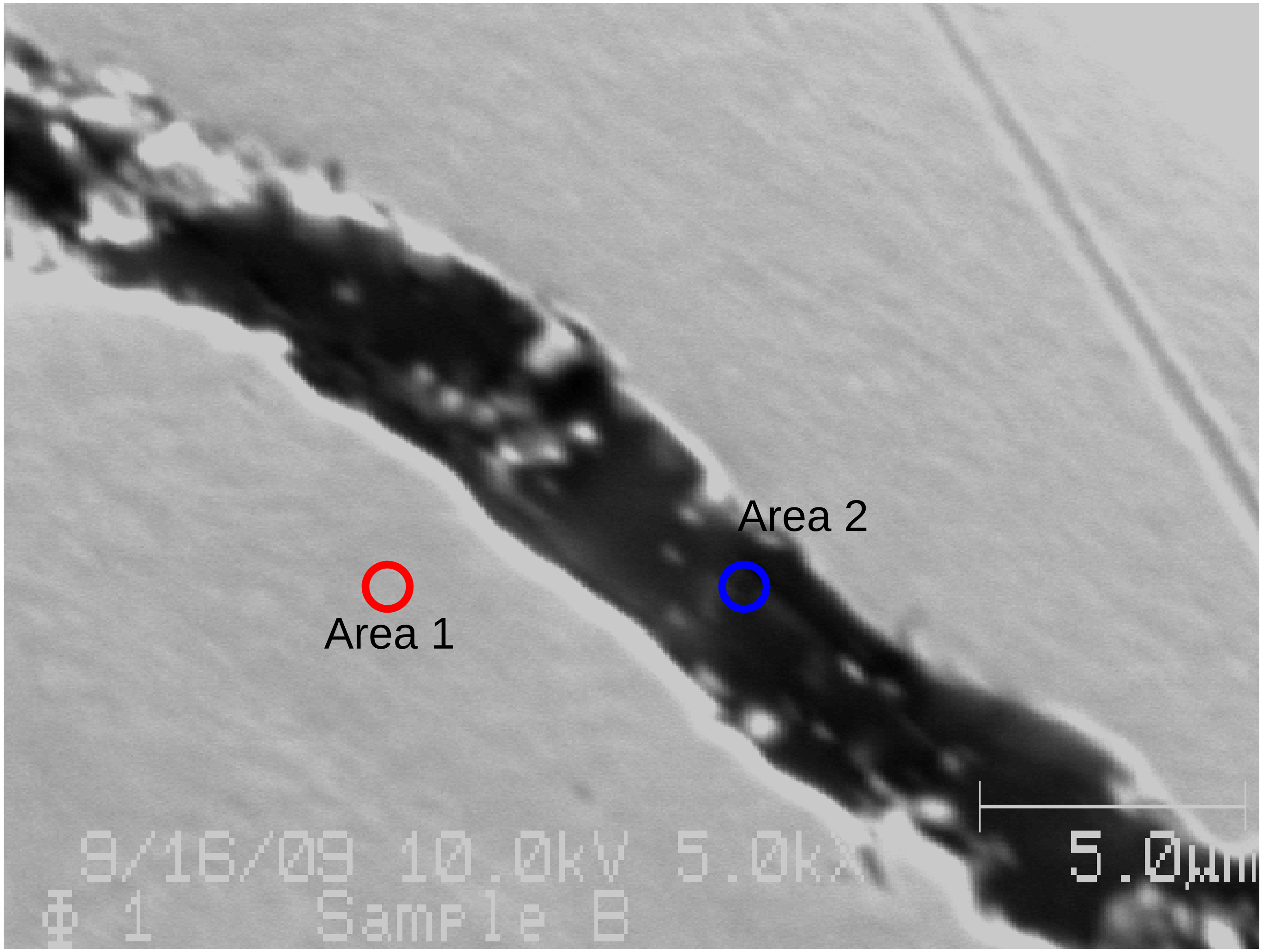
AES Survey Spectra: Sample B

P09ZB627203.spe: Sample B EAG
2009 Sep 16 10.0 keV 0 FRR 7.7332e+003 max 5.04 min
Sur1/Full/1 (S7D7)



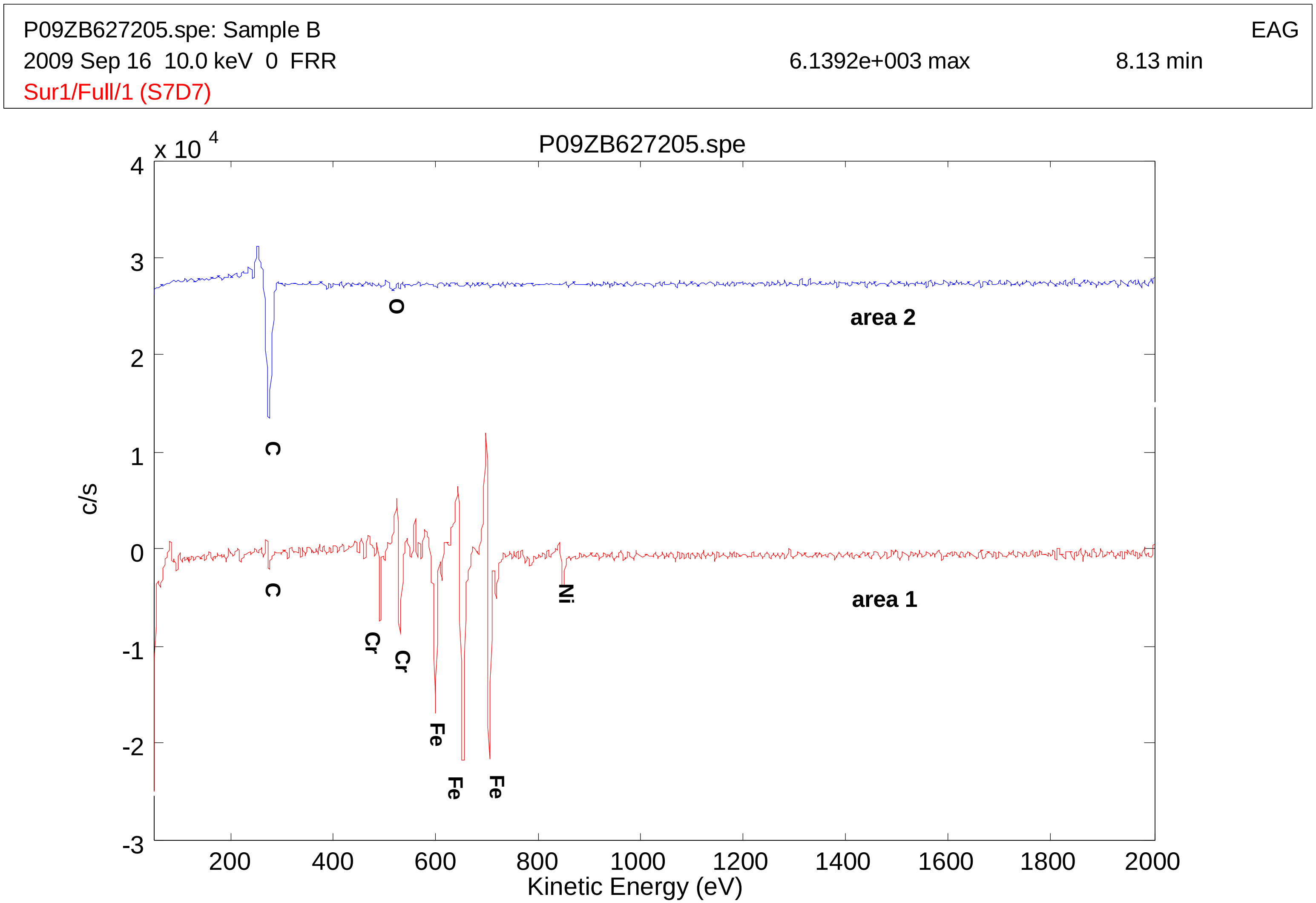
Figure

Secondary Electron Image: Sample B



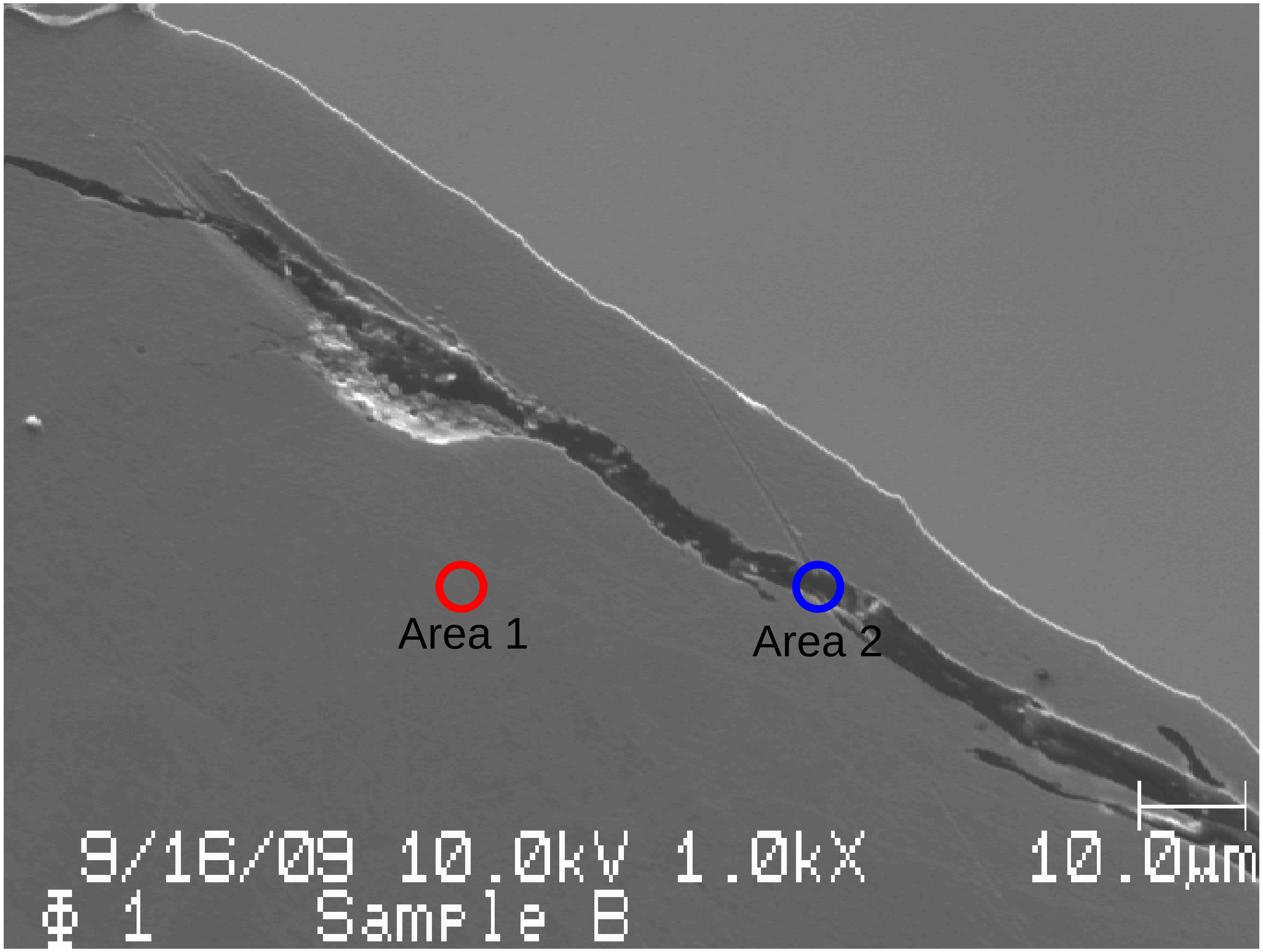
Figure

AES Survey Spectra: Sample B



Figure

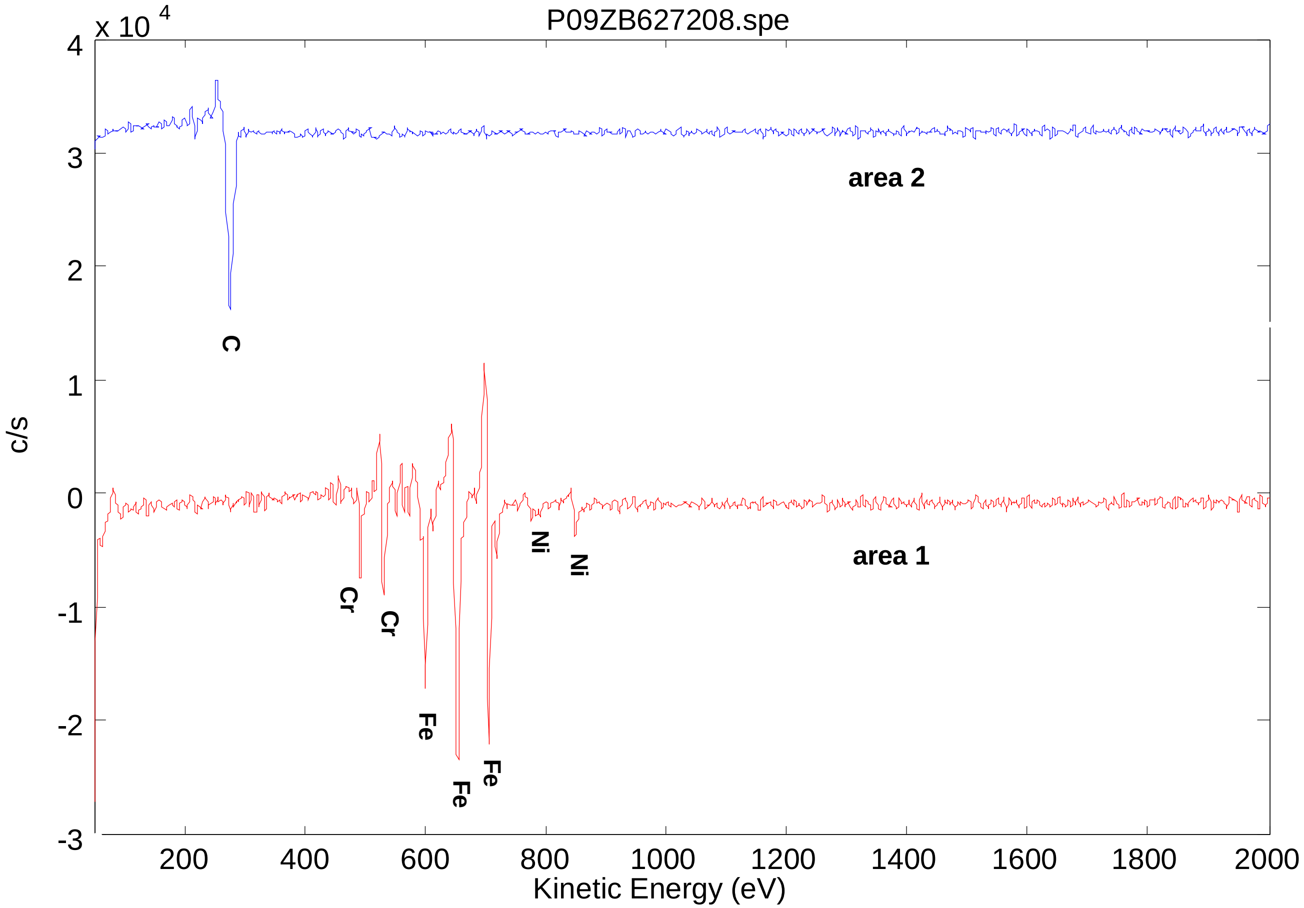
Secondary Electron Image: Sample B



Figure

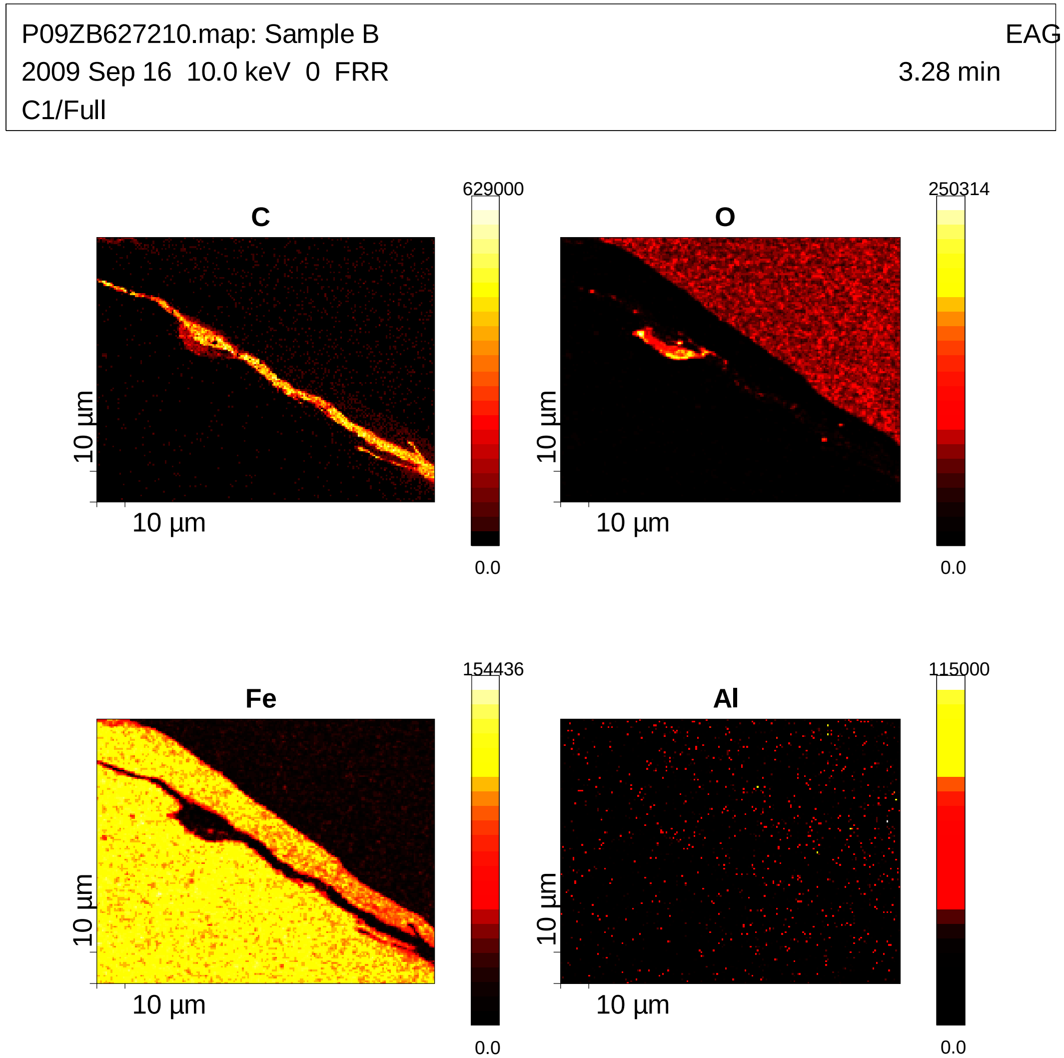
AES Survey Spectra: Sample B

P09ZB627208.spe: Sample B EAG
2009 Sep 16 10.0 keV 0 FRR 4.2676e+003 max 4.88 min
Sur1/Full/1 (S7D7)



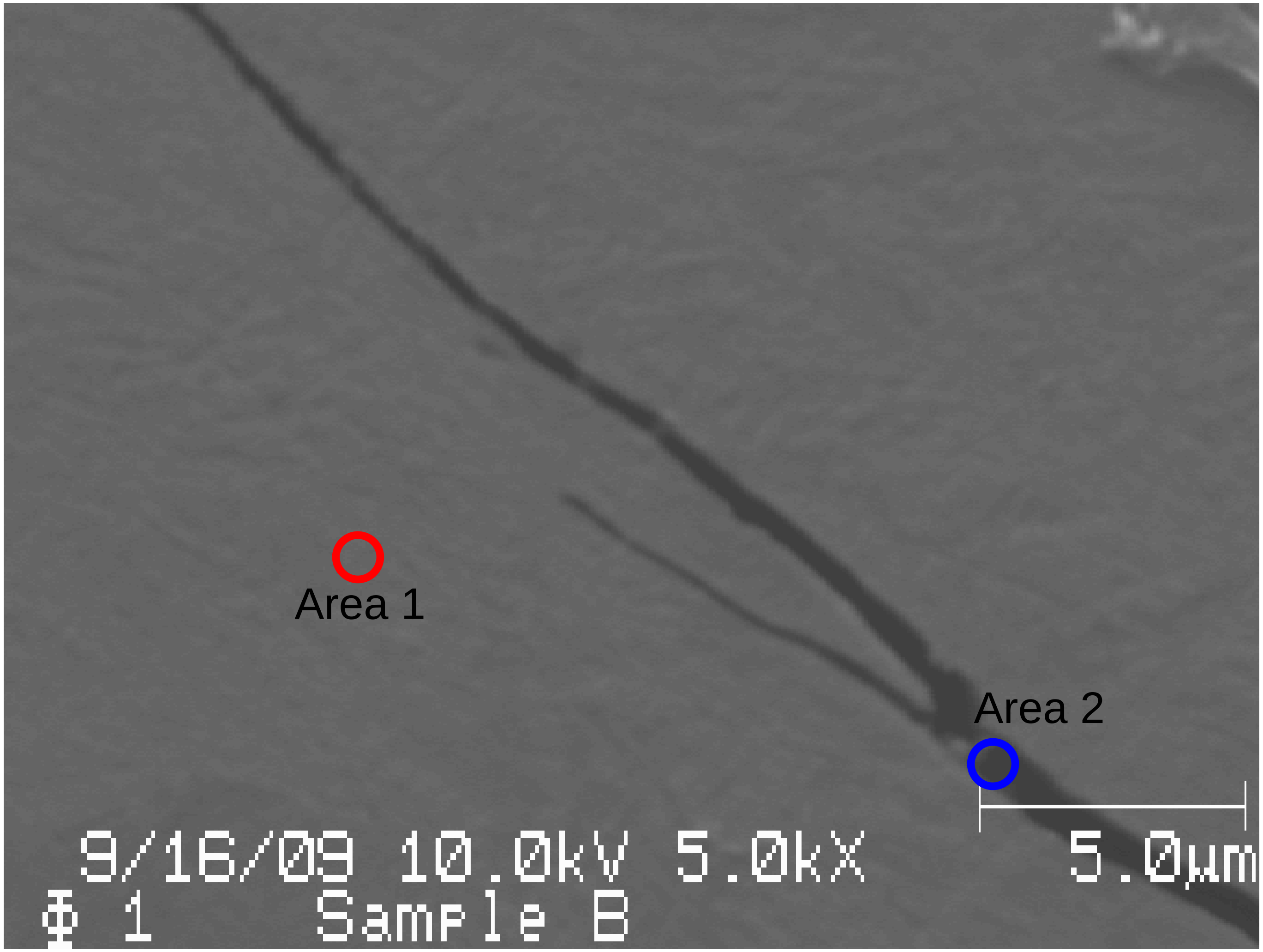
Figure

AES Maps: Sample B



Figure

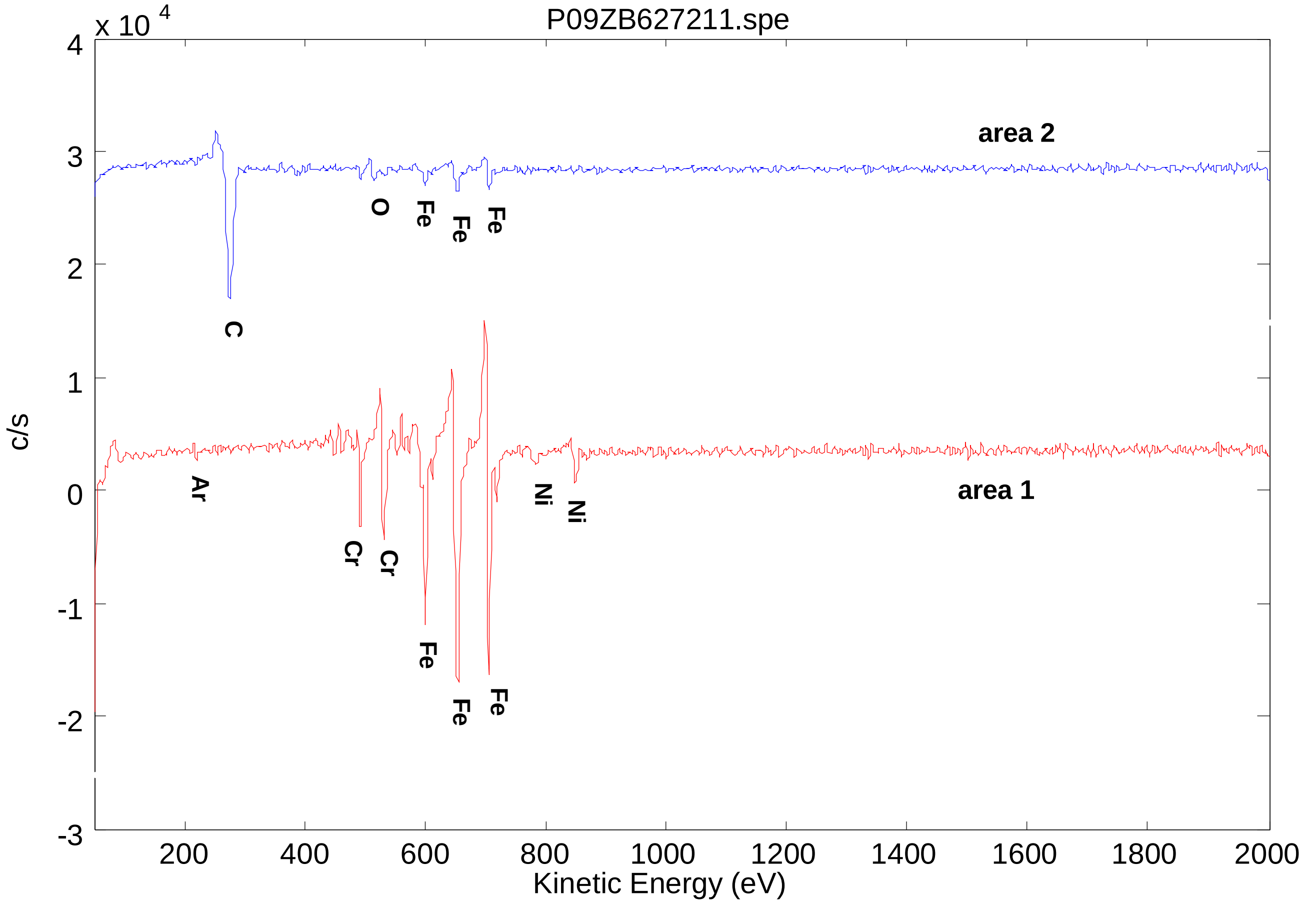
Secondary Electron Image: Sample B



Figure

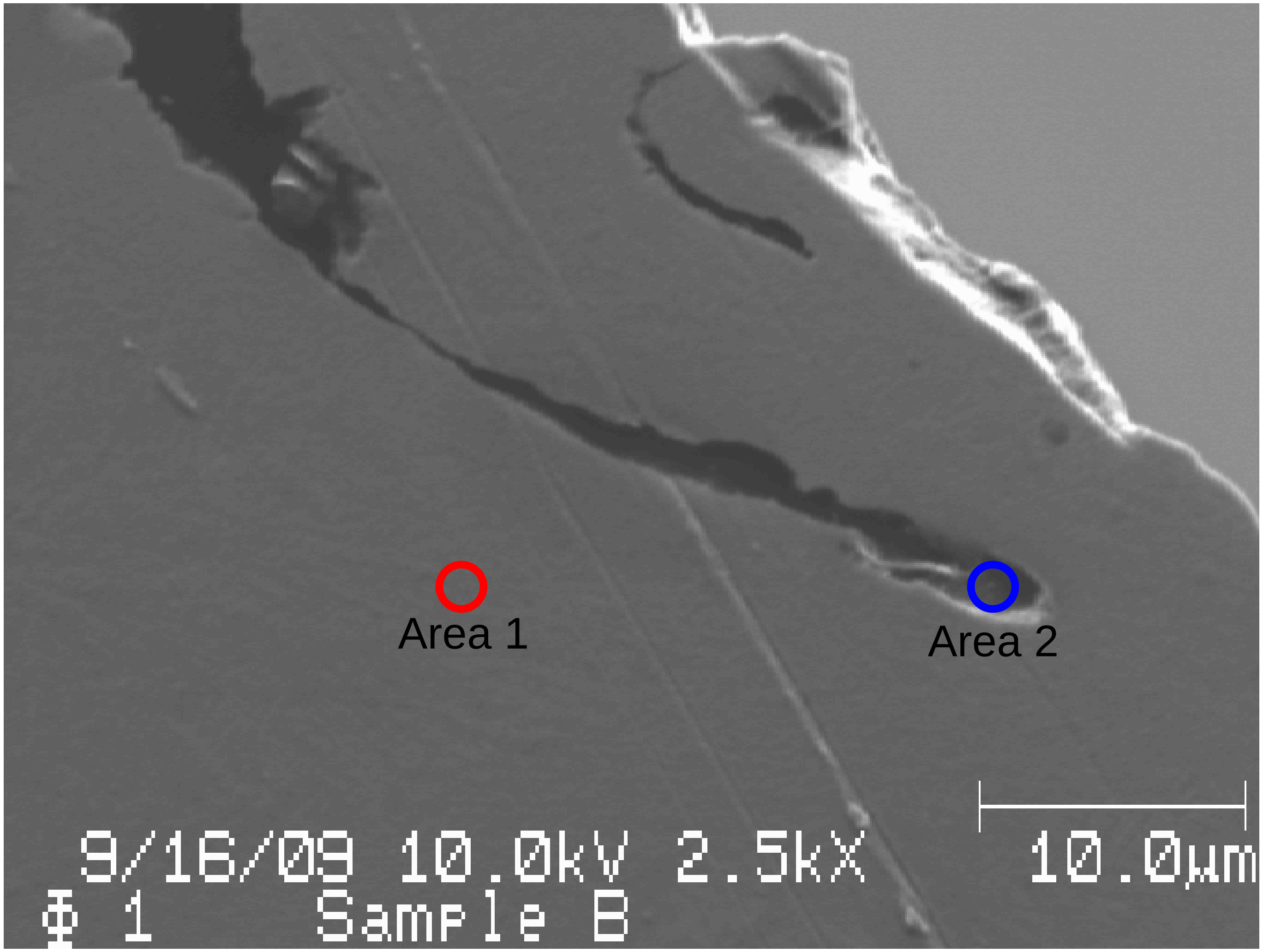
AES Survey Spectra: Sample B

P09ZB627211.spe: Sample B EAG
2009 Sep 16 10.0 keV 0 FRR 6.8835e+003 max 7.32 min
Sur1/Full/1 (S7D7)



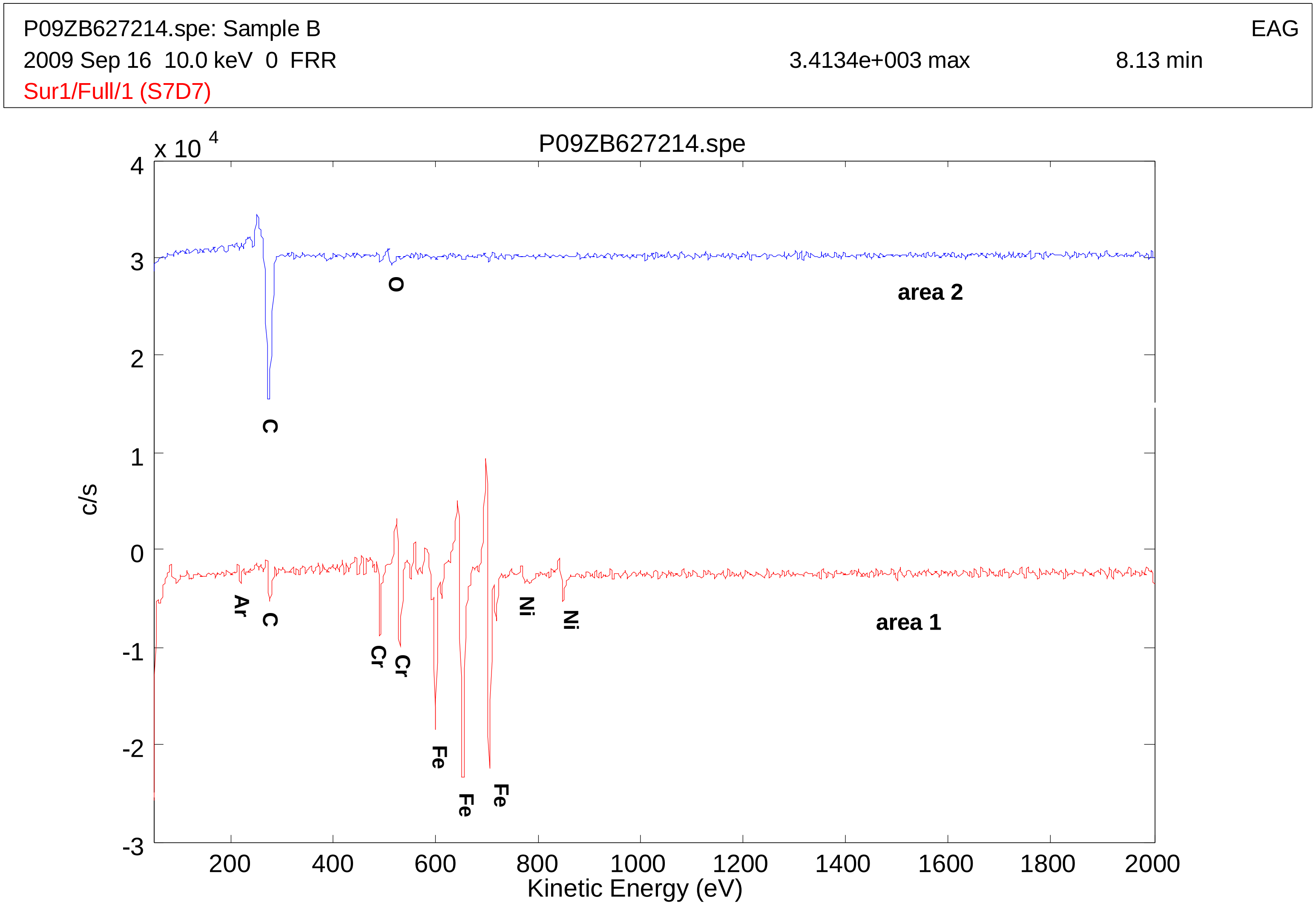
Figure

Secondary Electron Image: Sample B



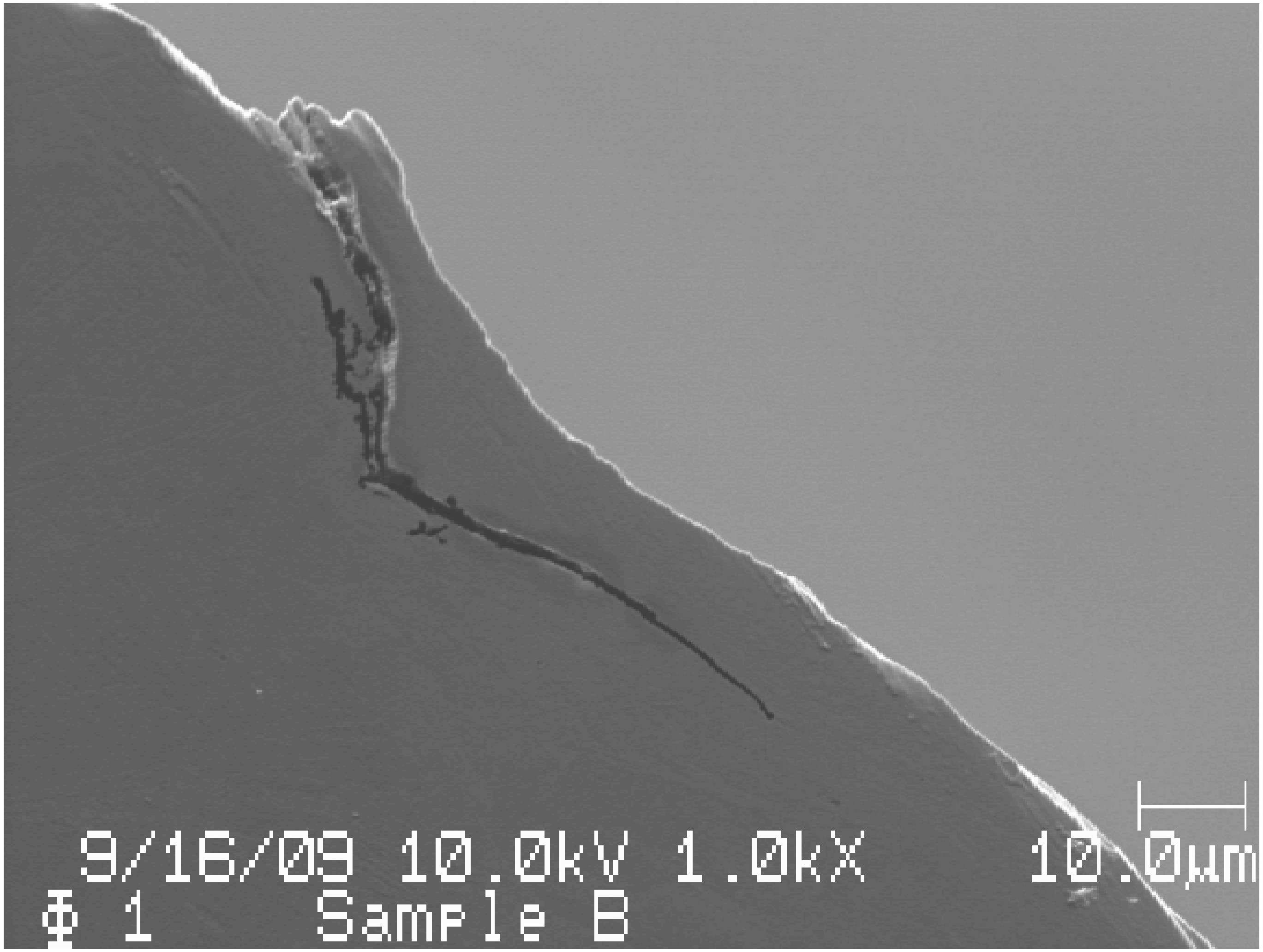
Figure

AES Survey Spectra: Sample B



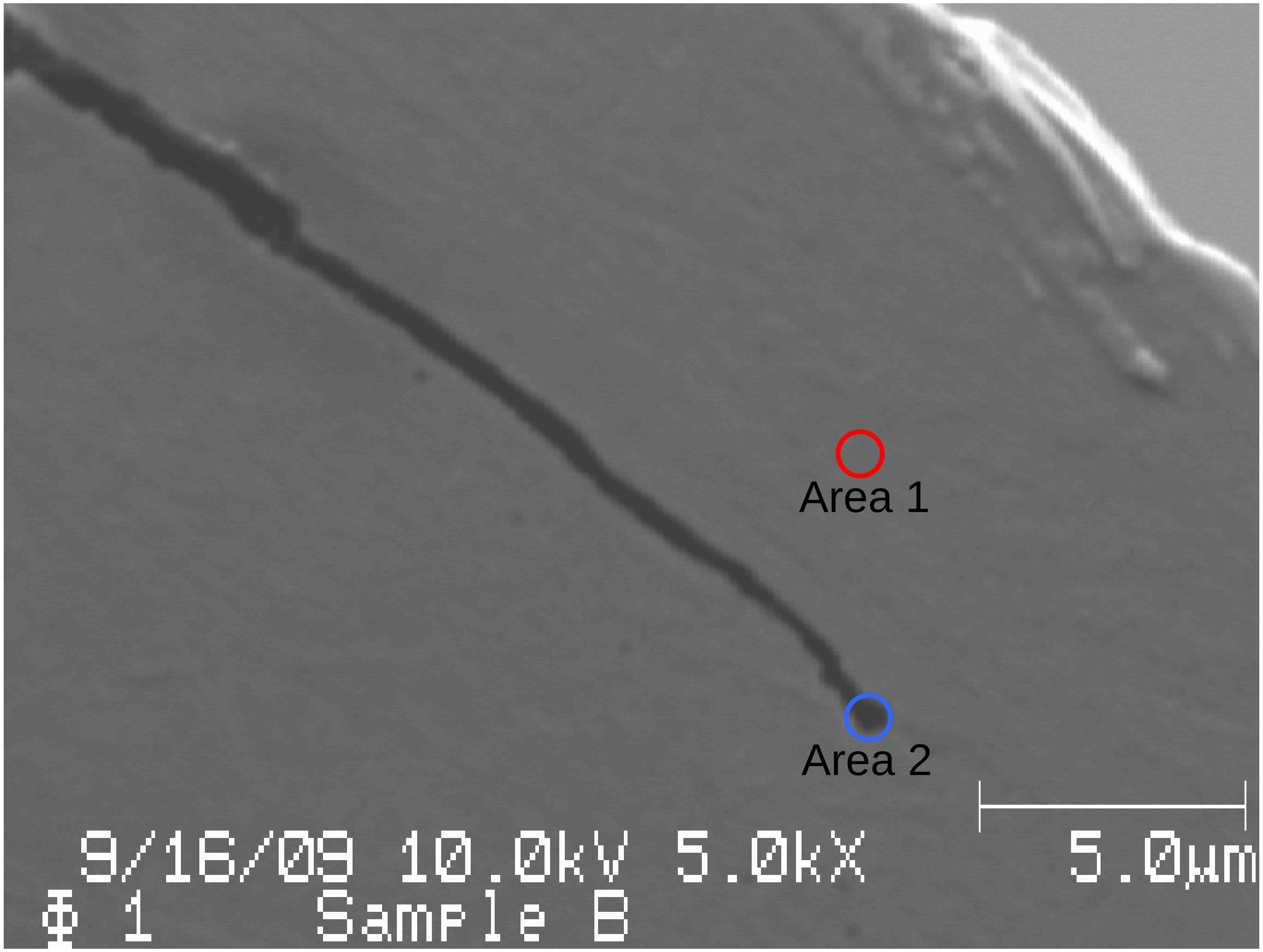
Figure

Secondary Electron Image: Sample B



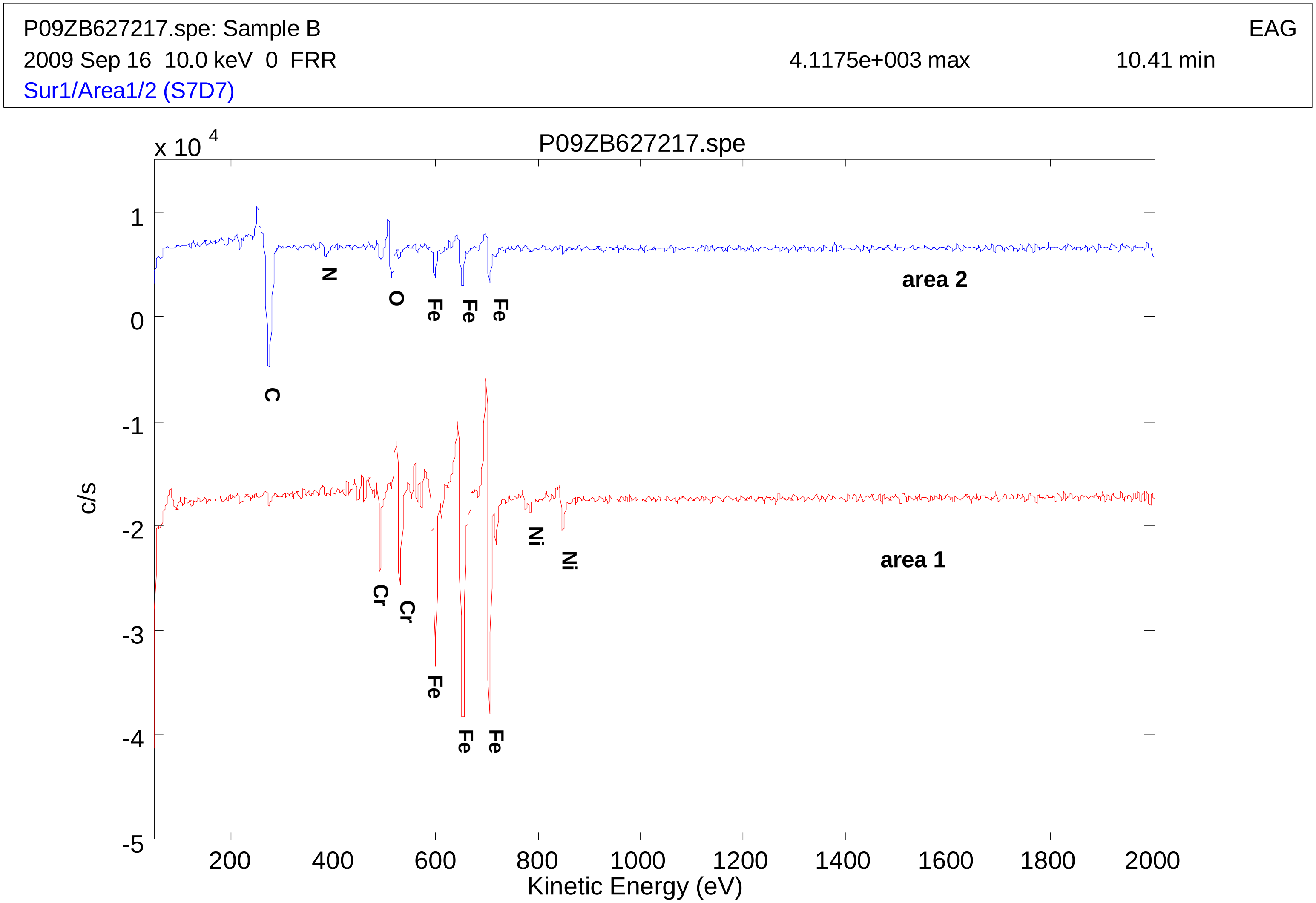
Figure

Secondary Electron Image: Sample B



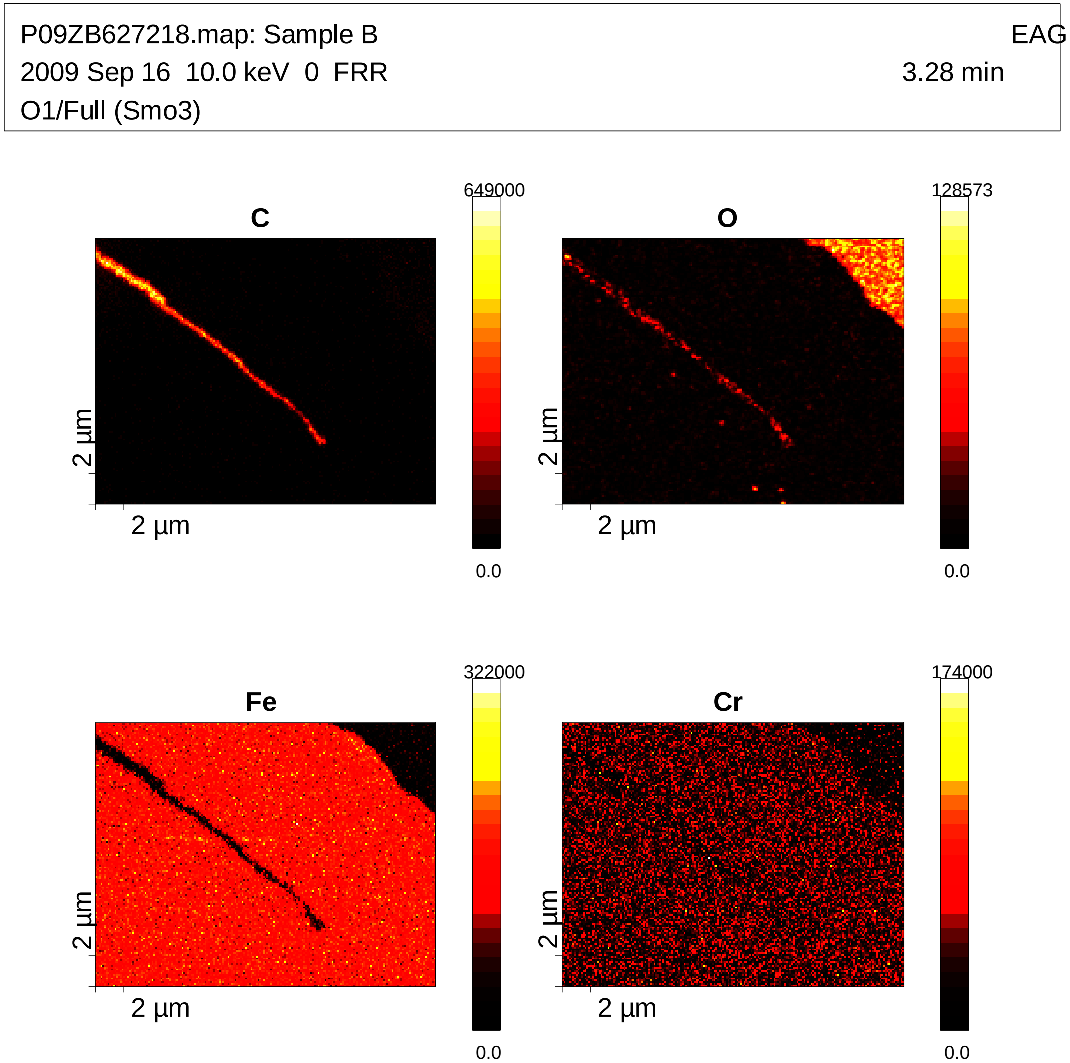
Figure

AES Survey Spectra: Sample B



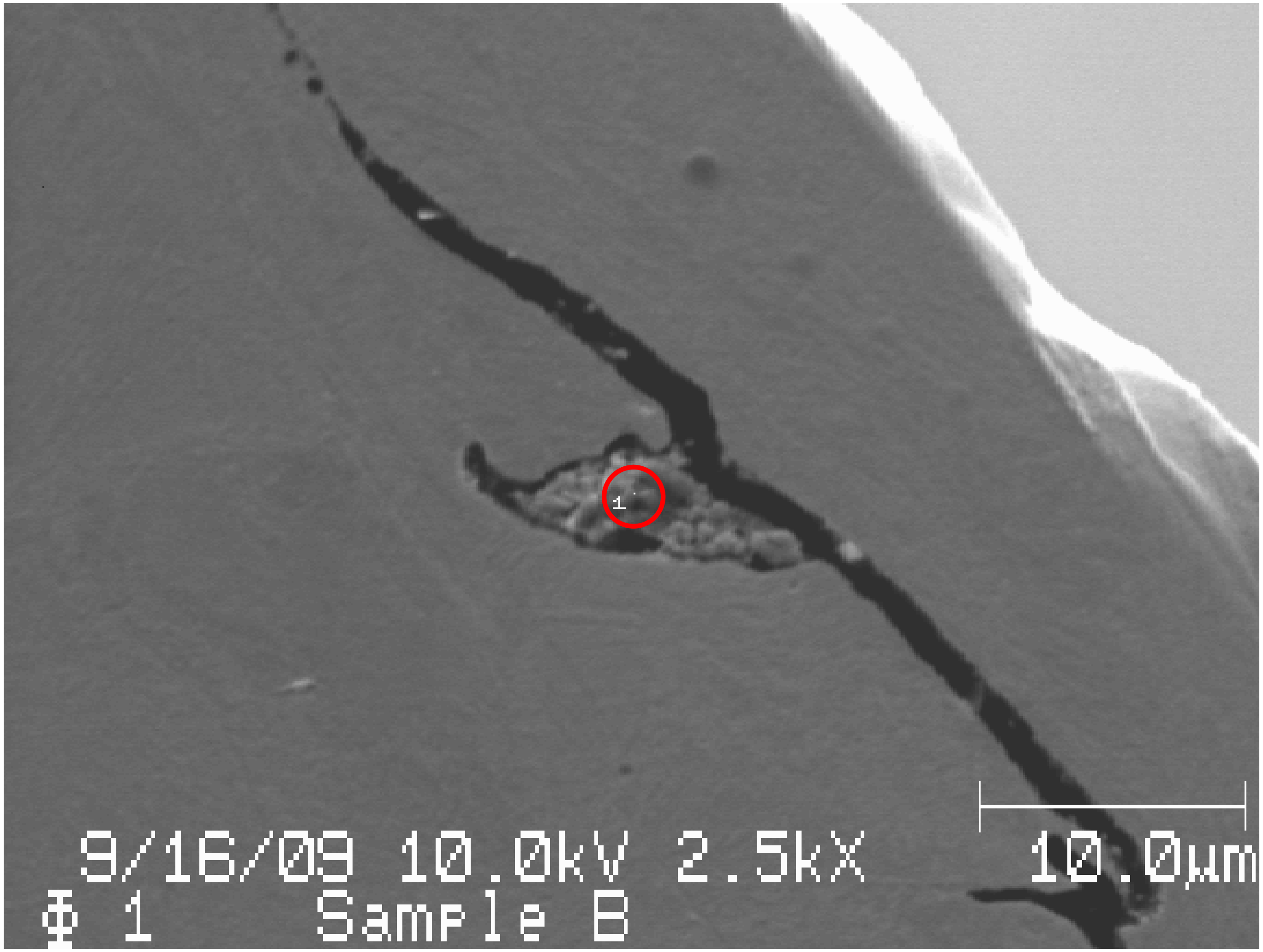
Figure

AES Maps: Sample B



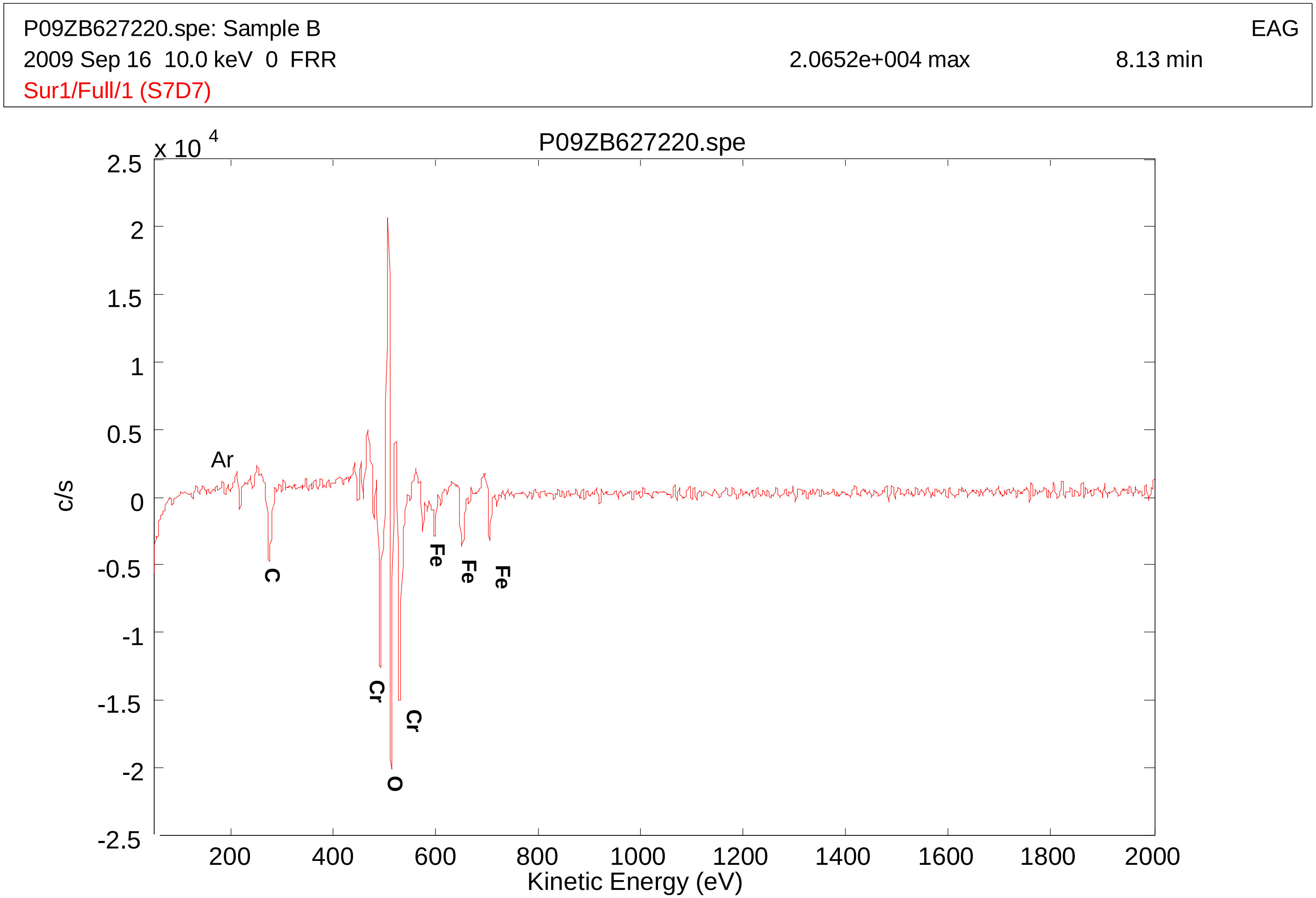
Figure

Secondary Electron Image: Sample B



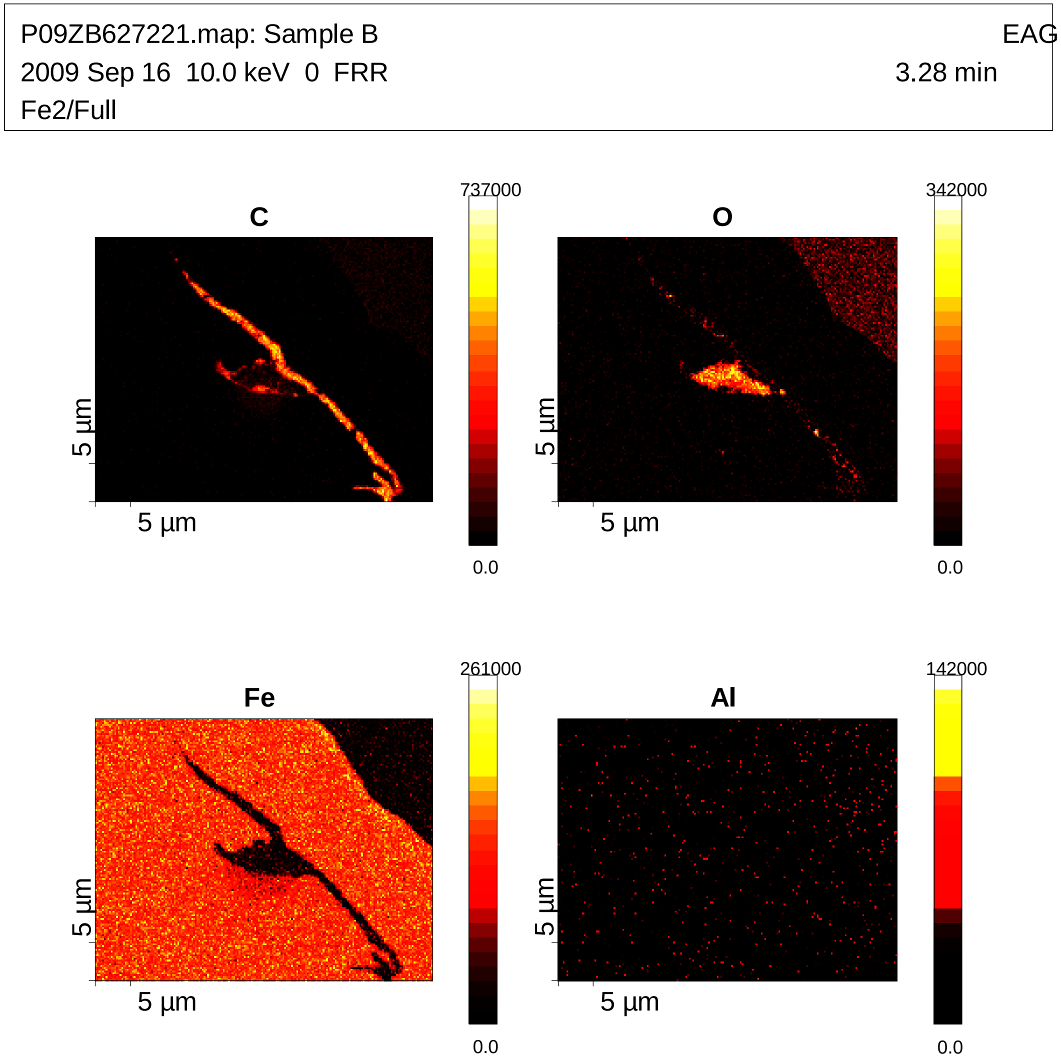
Figure

AES Survey Spectra: Sample B



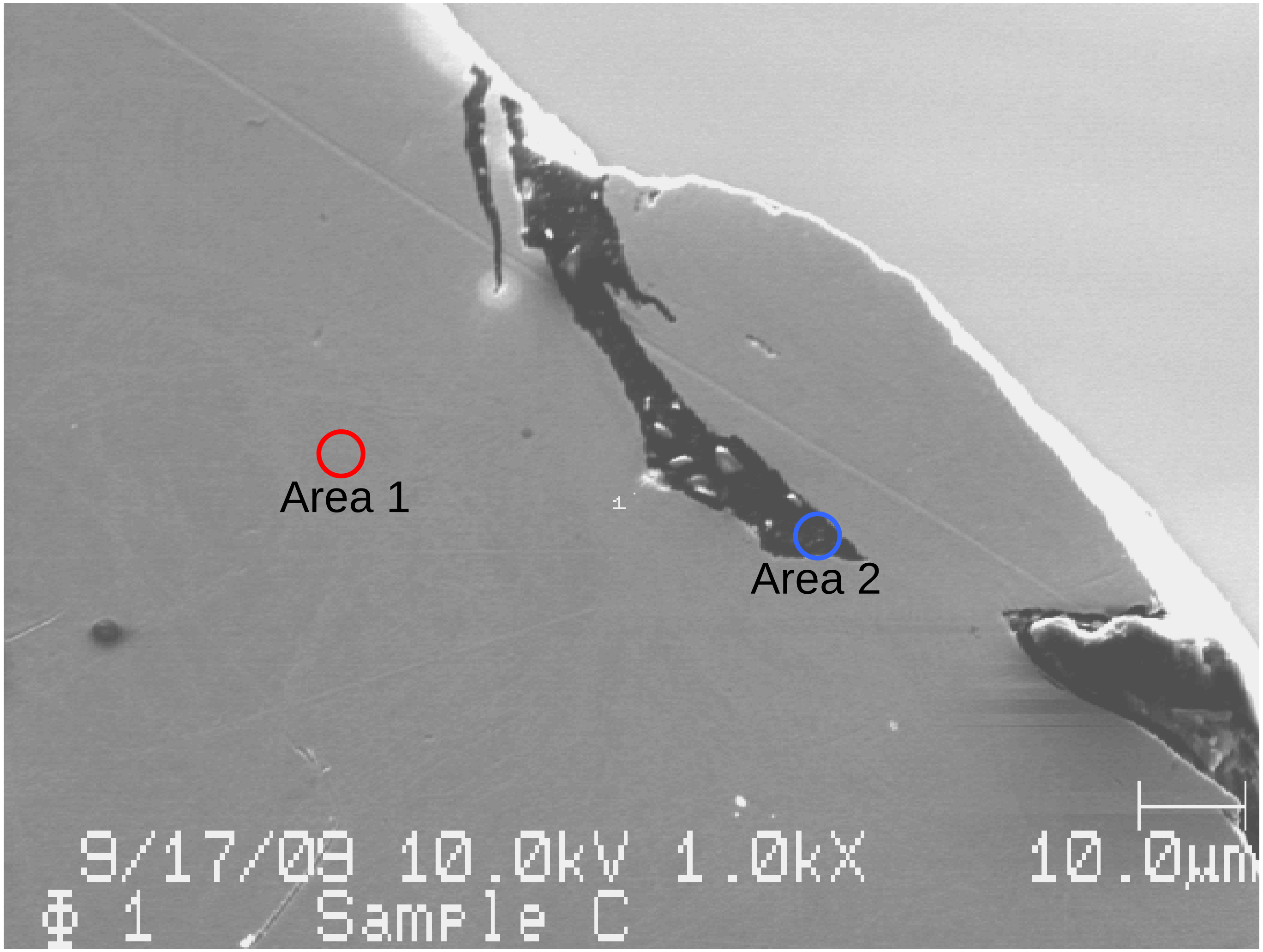
Figure

AES Maps: Sample B



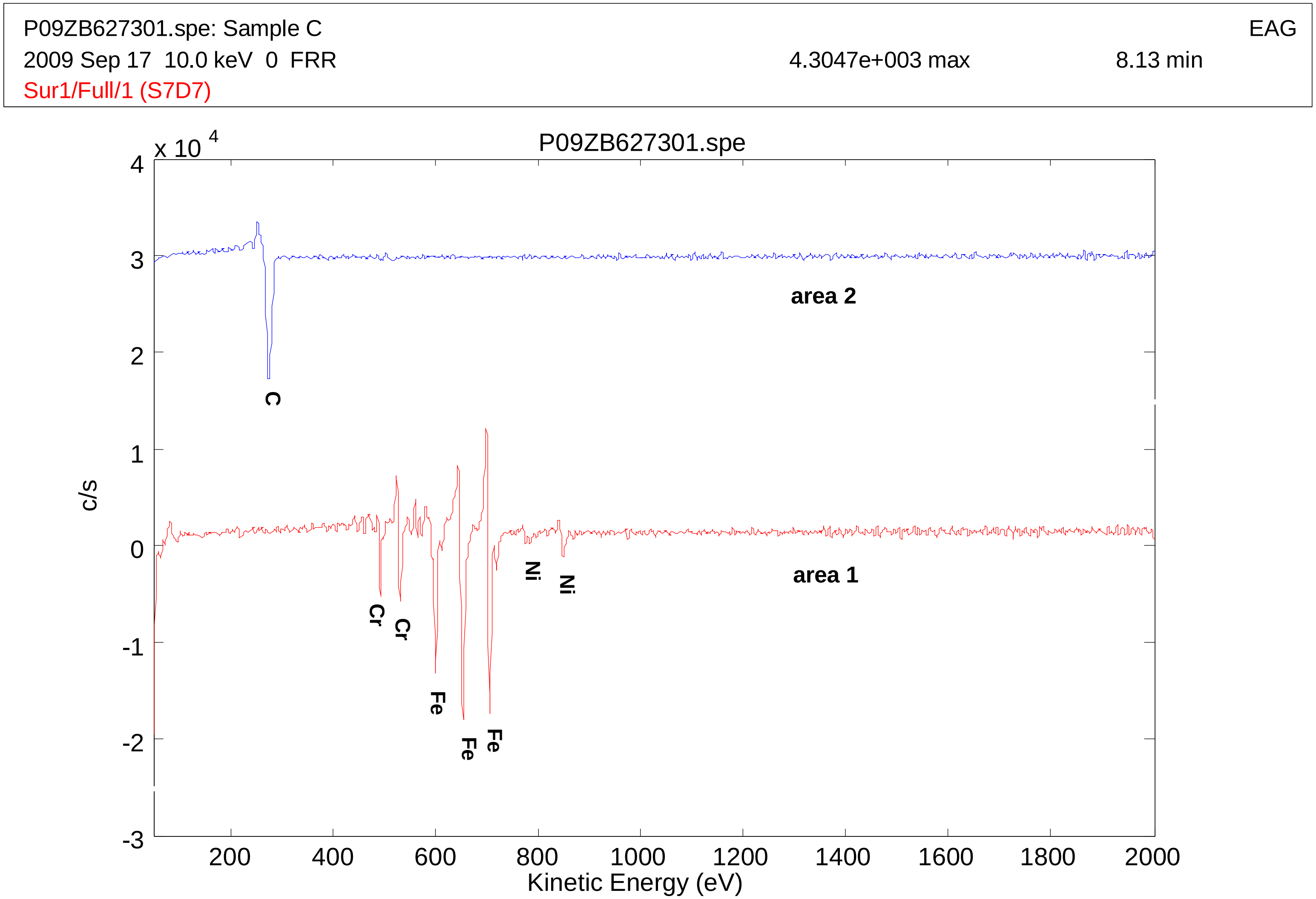
Figure

Secondary Electron Image: Sample C



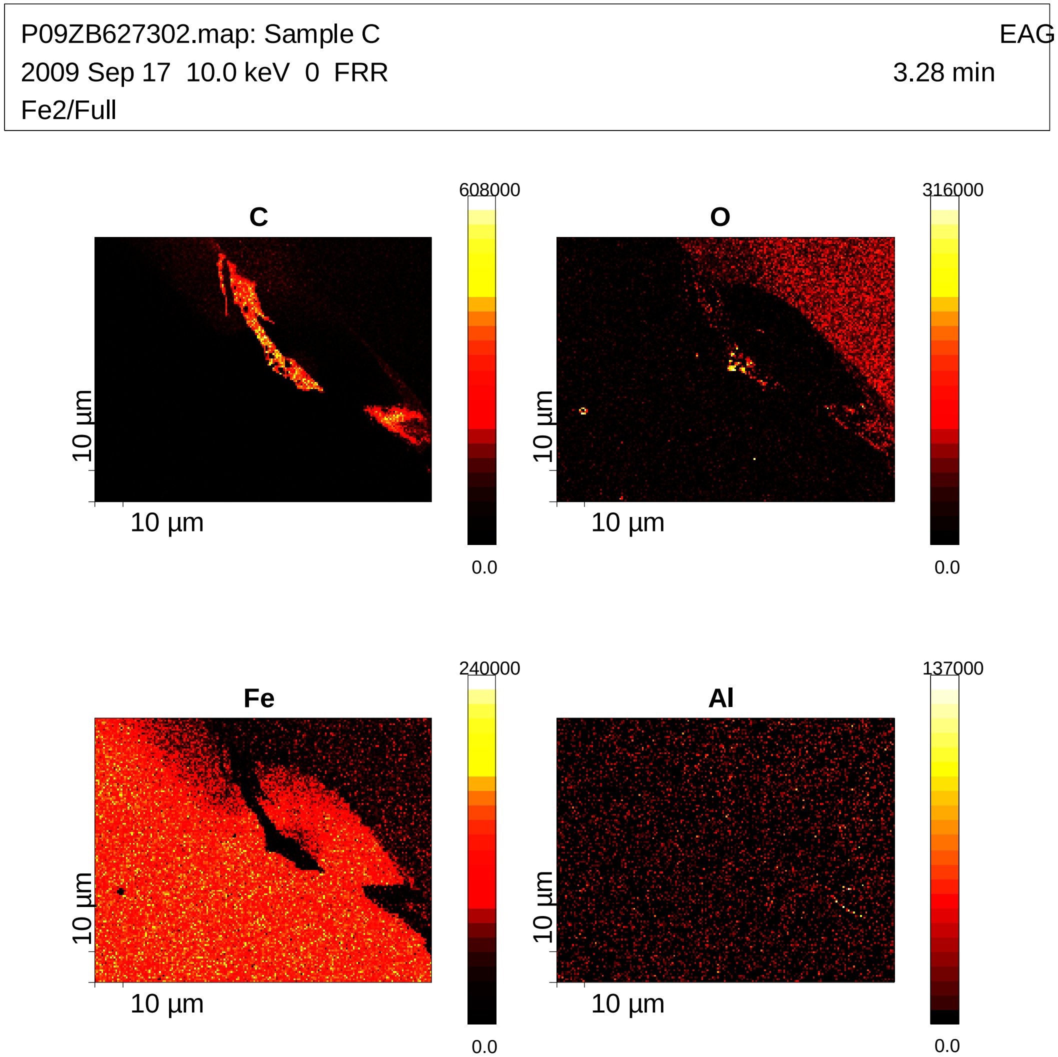
Figure

AES Survey Spectra: Sample C



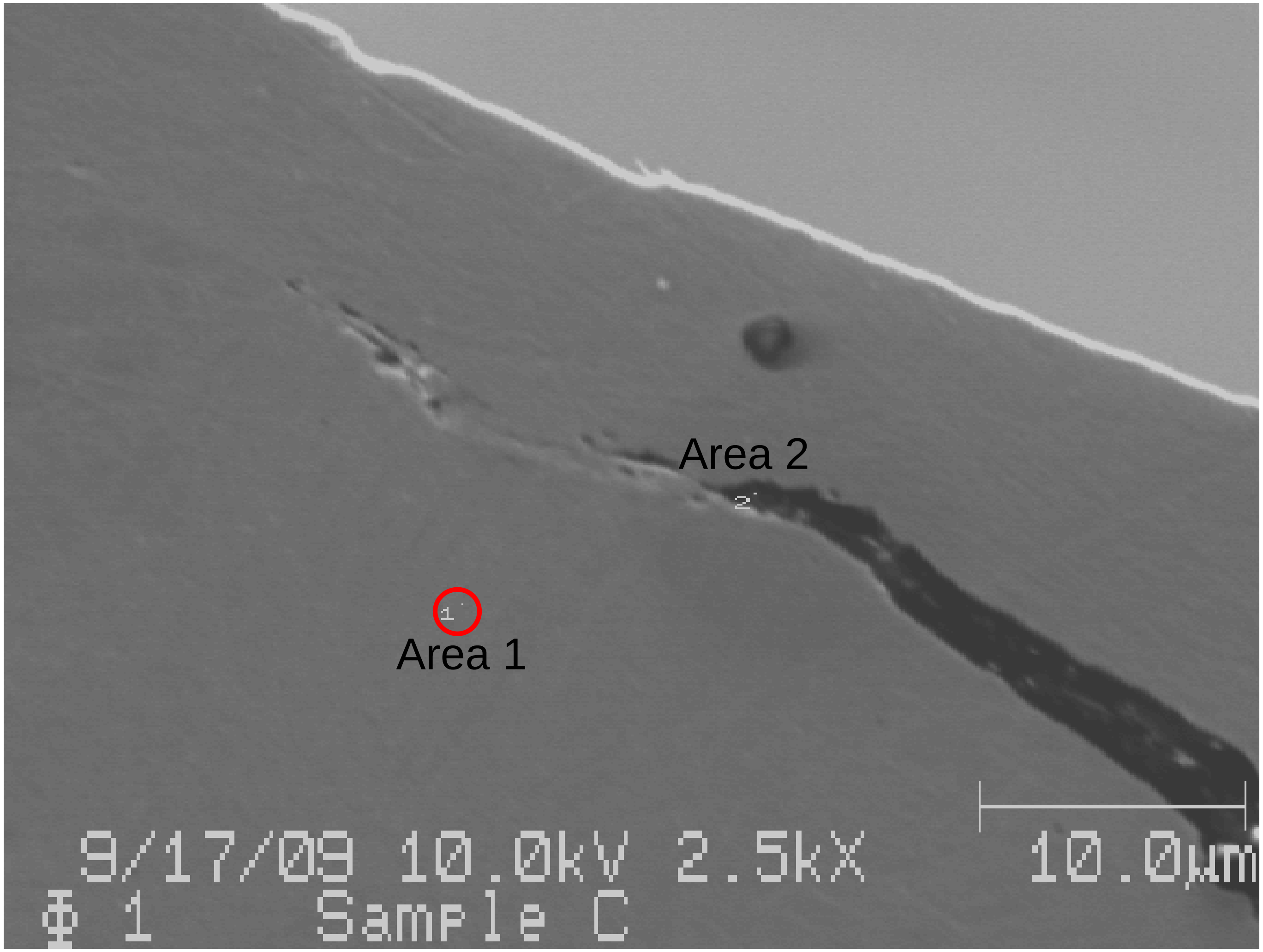
Figure

AES Maps: Sample C



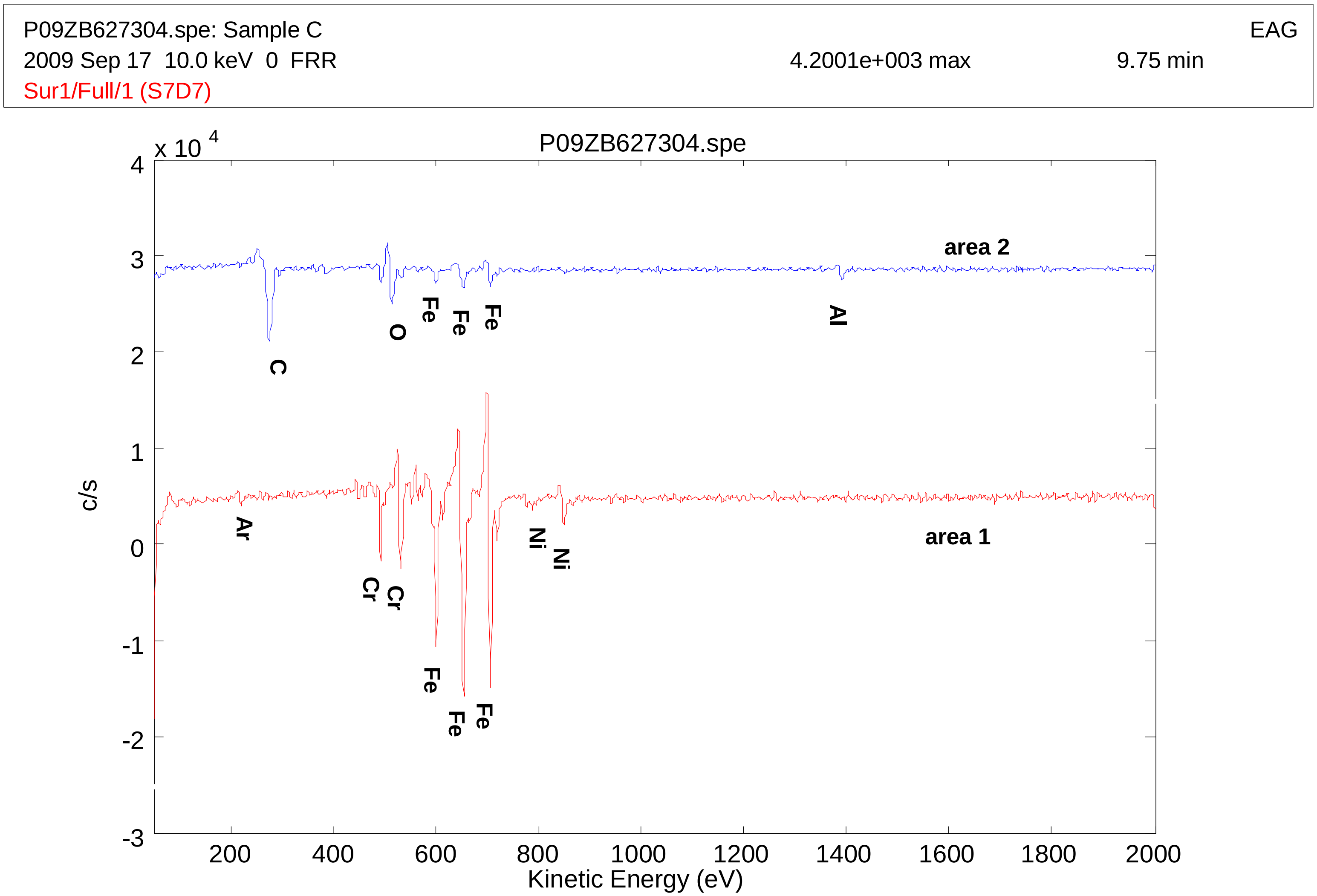
Figure

Secondary Electron Image: Sample C



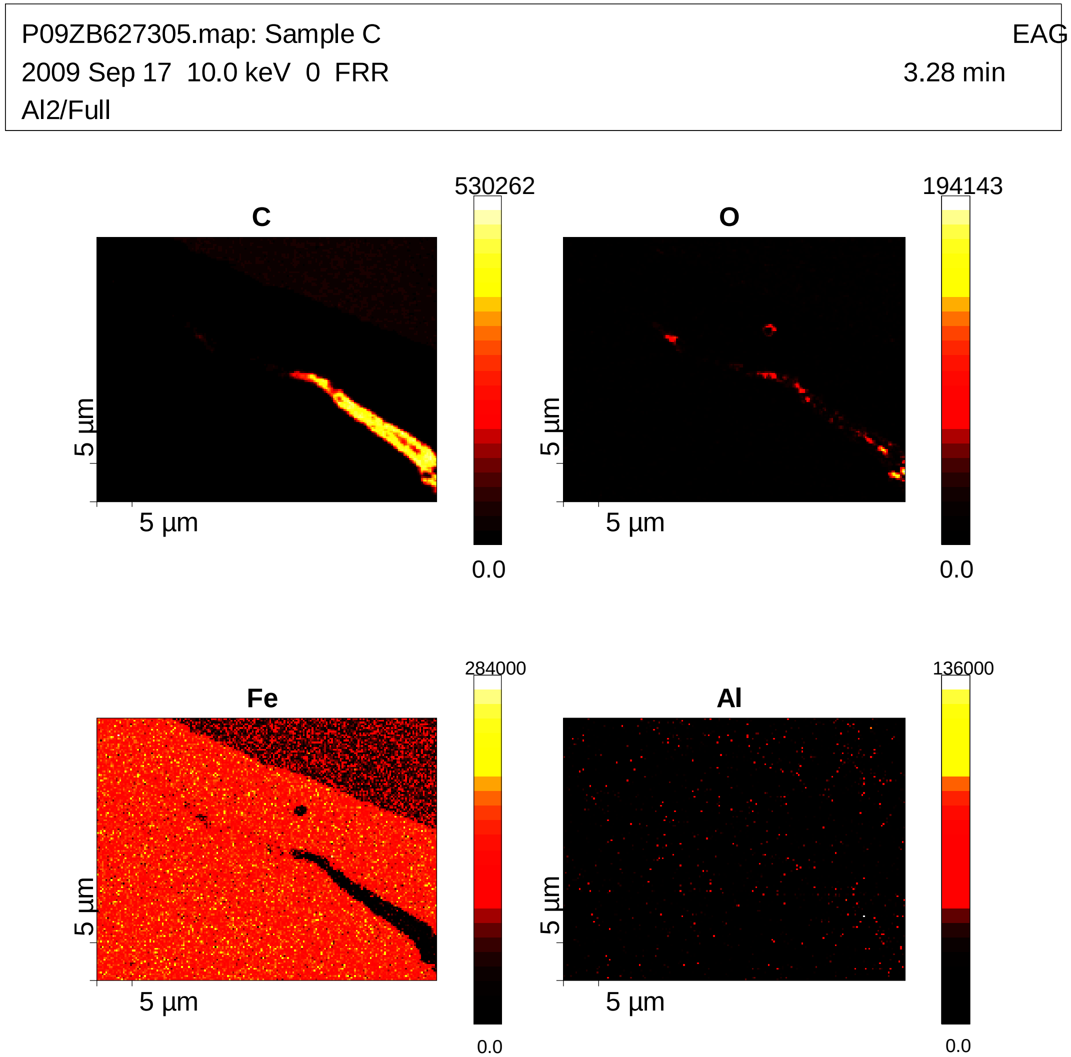
Figure

AES Survey Spectra: Sample C



Figure

AES Maps: Sample C



Figure

Laboratory Report

DuPont Emergency Response Solutions
901 West Dupont Avenue
Belle, WV

Prepared By: Wayne C. Appleton

Sample: Two (2) steel coupons submitted by Baker Engineering and Risk Assessment
Date of Report: October 3, 2009

Description of Testing:
The coupons were first examined microscopically and with a high-intensity light to determine whether there was any visual staining, corrosion, etc. No evidence of gross staining or corrosion was observed.

The coupons were then placed in beakers and liquid hydrazine was placed on one surface of each coupon. A control test was done using the same amount of hydrazine in a glass beaker without a coupon. The samples were observed using a high intensity light for a period of 2 hours. During this time there was no evidence of chemical reaction:

- No discoloration of either the coupon or the hydrazine liquid.
- No bubbling or other evidence of reaction
- No visible indication of any interaction of the hydrazine with the steel other than "wetting" by the hydrazine
- No formation of any precipitate.

The hydrazine used in this test was purchased from Aldrich Chemical Company and was sealed in a septum cap bottle that required a syringe to obtain a sample. The steel needle of the syringe reacted over a short time with the hydrazine to form a heavy white coating on the steel surface of the needle. No similar coating was observed on the steel coupons being analyzed. From this I conclude that chrome-plated steel or un-passivated steel does react with hydrazine.

After 2 hours a pipette was used to remove the hydrazine that had not evaporated. The hydrazine was examined visually with a high intensity light and no discoloration or turbidity observed.

The remaining hydrazine on the steel coupons was allowed to evaporate to dryness and the coupons were again examined with a high intensity light and microscopically. There was no evidence of any discoloration or chemical reaction. An examination the coupon did not show any evidence for any change or any evidence of reaction. There was no indication of any changes between areas of the coupon that were exposed or were unexposed to hydrazine.

The coupons were then water-washed and examined closely to determine whether there was any evidence of reaction. No discoloration, corrosion or other evidence of reaction was observed.

Conclusions and Recommendations

Based on our analysis, we do not believe that there will be an adverse chemical reaction when this trailer tank is used in hydrazine service. We would recommend however that the tank be examined after the first shipment to look for any evidence of excessive corrosion or chemical reaction and staining.